UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF CALIFORNIA
SAN JOSE DIVISION

APPLE IPOD ITUNES ANTI-TRUST LITIGATION	Lead Case No. C-05-00037-JW

Reply Declaration of Roger G. Noll

My name is Roger G. Noll, and I reside in Palo Alto, California. Previously I submitted the *Declaration of Roger G. Noll* (henceforth *Noll Report*) in this matter on whether the economic evidence that plaintiffs would use to prove liability and damages would be predominantly common to members of the direct purchaser class. That report contains information concerning my professional experience, including participation in recent antitrust cases.

Since the *Noll Report* was submitted in this matter, I have some additional publications, and so I attach my updated *curriculum vita* as Appendix A. I also have submitted expert reports and/or been deposed in the following cases.

Fair Isaac, et al., vs. Equifax, et al. (U. S. District Court, Minneapolis);

Minority Television Project vs. Federal Communications Commission (U. S. District Court, San Francisco);

Novell vs. Microsoft (U. S. District Court, Baltimore); and

In Re Flash Memory Antitrust Litigation (U. S. District Court, Oakland).

During the past year I also testified at trial in:

Bernard Parish, et al., vs. National Football League Players Association (U. S.

District Court, San Francisco).

ASSIGNMENT

Attorneys for direct purchaser class plaintiffs asked me to read the *Expert Report of Michelle M. Burtis* (henceforth *Burtis Report*) in support of the defendant's motion to decertify the direct purchaser class and to ascertain whether the information and analysis in that report causes me to alter anything in the *Noll Report*. In undertaking this task, I read the *Burtis Report*, the *Deposition of Dr. Michelle M. Burtis*, and the *Defendant's Motion for Decertification of Rule 23(B)(3) Class*. I also read the *Affidavit of Gary L. French* (henceforth *French Report*), the *Expert Report of Michelle M. Burtis*, and the *Order Denying in Part Plaintiff's Motion for Class Certification* (henceforth *Order*) in the indirect purchaser case. I also have relied on additional materials that are cited in the footnotes of this report, as well as my experience in other recent class action litigation, including the DRAM, SRAM and flash memory cases, all of which were filed in the Northern District of California.

SUMMARY AND CONCLUSIONS

This section briefly summarizes my analysis and conclusions. The basis for this summary, with supporting references, is contained in the main body of the report. My overall conclusion is that neither the *Burtis Report* nor any of the other material I have read causes me to change any of the opinions that I expressed in the *Noll Report*.

The *Burtis Report* addresses a single issue: whether the methods that I propose for calculating damages are reliable. Due to this narrow focus, most of the analysis and

conclusions in my report remain unchallenged. Dr. Burtis does not challenge my characterization of the economic issues that arise in this matter and my conclusion that predominantly common evidence would be used to prove liability, including harm to competition in portable digital media players. Dr. Burtis did not address whether individualized information would be required to prove damages for each class member. The essence of her report is that damages can not be estimated reliably, regardless of whether the plaintiff is an individual or a class, because no valid competitive benchmark exists for iPod prices that can be used to calculate the overcharge. Thus, the only matter that this reply needs to address is whether the damages arising from Apple's allegedly anticompetitive conduct can reliably be calculated, regardless of the number of plaintiffs.

Dr. Burtis offers the following criticisms of the *Noll Report.* One theme of the *Burtis Report* is that the *Noll Report* and the *French Report* are essentially the same, so that the Court's rejection of the methods proposed by Dr. French requires rejection of my methods. The *Burtis Report* states that the *Noll Report* and the *French Report* share the following basic flaws. First, neither developed an actual model, proposed any equations, or identified any variables that would be used in calculating damages. Second, neither presented any data or showed that data exist to implement the proposed methods. Third, neither proposed ways to overcome obstacles to implementing these methods. I do not believe that these are valid criticisms of the *Noll Report*.

Dr. Burtis's first two "flaws" are derived from the standard that Dr. Burtis adopts for proving that a damage method can be implemented. Dr. Burtis's standard is that a damage formula must be completely specified, data must be collected, and the damage method must be shown to work prior to discovery of essential proprietary data from the

defendant that are necessary to implement the proposed method. If this requirement were the standard for determining whether a method for proving damages is feasible, no class could be certified prior to discovery of the relevant information from the defendant. As explained in the *Noll Report*, the specification of the common formula for calculating damages must reflect the actual pricing policies of the defendant, must use variables that are contained in the defendant's transactions records, and must be based on a pricing equation that takes into account technical features of iPod products that may affect demand. The defendant has produced neither documents about its pricing policies, transactions records, nor technical specifications for each iPod model, so that an equation that explains the defendant's pricing cannot yet be specified or estimated, regardless of whether the plaintiff is a class or an individual.

The problem of insufficient discovery cannot be solved simply by converting this litigation from a class action to a case involving only named plaintiffs because, after such a conversion, the named plaintiffs still would need the same discovery that the class requires in order to produce a formula for proving damages. If, despite Dr. Burtis's expectations that no reliable damages method is possible, these named plaintiffs proved their damages, the method that they would use to prove it would be equally valid for all other class plaintiffs.

Dr. Burtis is incorrect in claiming that the *Noll Report* and the *French Report* are basically the same. The reports differ in five important ways.

(1) Dr. French had to propose methods for calculating both the overcharge to direct purchasers and pass-through to indirect purchasers. Proving pass-through is more complicated than proving an overcharge because

it involves collecting retail price data from a reasonable sample of retail outlets, and then showing that changes in wholesale prices to those outlets cause changes in retail prices.

(2) The discussion of methods for estimating direct purchaser damages in the *Noll Report* is roughly three times as long as Dr. French's discussion of both the overcharge to direct purchasers and pass-through, even though my discussion covers only the first stage of the process that Dr. French must analyze.

(3) Dr. French proposed aggregating individual transactions prices into monthly average prices. I proposed using Apple's transactions data to estimate damages. None of the methods proposed in the *Noll Report* is based on average prices.

(4) The discussion of sources of market power, harm to competition, and damage calculations in the *Noll Report* describe variables that would be used to capture the effects of technology and demand on prices. The variables that would be used to determine harm to competition also would be used to calculate damages. No similar discussion appears in the *French Report*.

(5) Dr. Burtis claims that the *Noll Report* and the *French Report* share a failure to take into account when anticompetitive harm and damages started. This assertion is incorrect. The enhanced value for the iPod arose immediately with the establishment of the iTunes music store (ITMS). As explained in the *Noll Repor*t, two events elevated demand

for iPods: the creation of ITMS for the Apple Macintosh, and the extension of access to ITMS to all personal computers.

Dr. Burtis asserts that no valid competitive benchmark exists for iPod prices. She rejects the before-after test because the "before" period was short compared to the class period and because iPod has evolved technologically since the alleged exclusionary conduct. Economics research contains numerous studies that use measures of product attributes to explain price changes over time, including studies of consumer electronics products that evolve rapidly. This approach has been applied successfully to construct damage models in other class action antitrust litigation, including DRAM and SRAM memory chips.

Dr. Burtis rejects the comparable products and mark-up tests because she asserts that no benchmark products or mark-ups are available. This assertion is invalid because it incorrectly equates the benchmark requirements for the two methods. For the yardstick method, the *Noll Report* suggests other portable digital media players as comparable products. Dr. Burtis gives no reason for rejecting this benchmark. Dr. Burtis rejects the other proposed benchmarks because the products are not functionally similar to iPods, but functional similarity is not a requirement for a benchmark. If it were, the yardstick method would be impossible to implement because the benchmark products would be substitutes and hence in the same market. The actual requirement is that the products have similar production technologies, inputs, demand conditions, and sales.

Dr. Burtis seems to believe that a comparable product must be found to implement the mark-up method, but this claim is based on an incorrect understanding of the method. As explained in the *Noll Report,* the mark-up method compares price-cost

margins for the products at issue with typical mark-ups of leading firms in similar industries that are free of anticompetitive conduct. One version of the mark-up method implements a theoretical model of a concentrated market, calibrates the model to the existing market structure, and uses the same model to calculate the price effect of a change in competition. This version, which has been widely used by economists to study the competitive effects of anticompetitive conduct, requires no benchmark product.

Dr. Burtis provides no details about her assertion that I fail to propose solutions to problems that must be overcome to produce a reliable damages model. The only such issues that I can identify in her report are her remarks about the importance of "coolness" in explaining the iPod's popularity and the necessity to take into account lost profits from ITMS that might arise from the defendant's alleged exclusionary conduct.

The assertion that a damages model must take into account the "coolness" of the iPod has no supporting evidence. Dr. Burtis believes that by simply uttering the word coolness, without explaining what it is or why it matters, she can create a problem that I must solve. In fact, the concept of coolness is not a topic of systematic research, lacks a clear definition, and has not been shown to be quantitatively significant in explaining sales or profits. Moreover, the identification of the iPod as "cool" took place when the iPod was first introduced, so its effect, if any, would have been present prior to the effects of the defendant's alleged anticompetitive conduct. Whereas Dr. Burtis is entitled to develop empirical evidence that coolness is a significant factor explaining the greater success of the iPod after the beginning of the class period, she has not done so nor has she even provided any evidence to this effect.

Dr. Burtis believes that the overcharge to direct purchasers overstates damages

because the prices for downloading files from ITMS would rise in the absence of the alleged exclusionary conduct. Setting aside whether this argument is correct as a matter of law, it is incorrect as a matter of economics for two reasons. First, the direct purchaser class includes distributors and retail chains, neither of which purchase files from ITMS. These class members have no offsetting benefit from lower ITMS prices. Second, for consumers who purchased iPods from Apple, there is no basis for believing that prices at ITMS were affected by the exclusionary conduct. As a matter of economic theory, the connection of ITMS prices to the exclusionary conduct is ambiguous, and empirically Dr. Burtis offers no evidence that the effect exists, let alone is negative.

For these reasons, I do not believe that Dr. Burtis has produced any analysis or evidence that casts doubt on the analysis and evidence in the *Noll Report*. The basis for the conclusions summarized above is contained in the remainder of this report.

THE THEMES OF THE *BURTIS REPORT*

The *Burtis Report* deals only with the feasibility of methods to calculate damages. The *Burtis Report* does not discuss whether the damages methods that were proposed in the *Noll Report* were based on methods that were predominantly common to class members. In her deposition Dr. Burtis agreed that the problems that she has with my proposed methods would apply to individual plaintiffs as well.[1] In the next section, I discuss Dr. Burtis's criticisms of the damages methods that I proposed in the *Noll Report*.

This section discusses five other aspects of the *Burtis Report* that are relevant for class certification: the absence of an analysis of liability issues in the *Burtis Report*; the

[1] *Ibid.,* pp. 27-40.

assertion by Dr. Burtis that the analysis in the *Noll Report* is essentially the same as the analysis in the *French Report*; the claim by Dr. Burtis that a flaw in the *Noll Report* is that I did not collect data and propose an equation; the conclusion by Dr. Burtis that "coolness" is an important factor explaining the demand for iPods that must be taken into account in calculating damages; and the assertion by Dr. Burtis that any method for calculating damages must take into account the effect of the defendant's anticompetitive conduct on the prices for audio and video recordings on ITMS.

Common Proof of Liability

Dr. Burtis does not address any liability issues, and testified that she has not thought about how market definition and market power would be proved in this matter, or whether the defendant had business justifications for its alleged anticompetitive conduct.[2] Hence, Dr. Burtis does not express any disagreement with the conclusion in the *Noll Report* that economic analysis that is common to class members could be used to establish market definition, market power, anticompetitive conduct as a source of market power, and harm to competition.

The absence of disagreement with my analysis of liability issues is important, because liability and damages are closely linked. The economic evidence that is relevant to proving liability is the presence of higher prices to consumers in a relevant market as a result of anticompetitive conduct. If the allegations in the *Complaint* are true, portable digital media players are a relevant product market, the defendant enjoys monopoly power in that market, and the defendant's market power was created, increased or

[2] *Deposition of Michelle M. Burtis, Ph. D.*, September 30, 2009, (henceforth *Burtis Deposition*), pp. 161, 166-67.

maintained by anticompetitive conduct. As explained in the *Noll Report*,[3] these allegations, including whether the defendant's anticompetitive conduct harmed competition, would be proved by showing that the market share and profit margin of the iPod were higher after the launch of ITMS.

To avoid falsely attributing changes in profit margins to the alleged exclusionary conduct, one adjusts differences in profit-margins across models of portable digital media players for differences in qualitative attributes. As explained in the *Noll Report*,[4] in a competitive market, the difference in the price of two models will equal the difference in cost, but for models of iPod that differ only in memory, published scholarly research estimates that the price differential is double the difference in component cost.[5]

The analysis of the excess margin for memory is based on an estimate of Apple's costs and wholesale prices for iPods, and so would need to be adjusted for actual costs and wholesale prices when discovery makes these data available. If this result holds up when actual costs and prices are used, it would demonstrate that Apple has sufficient market power in iPods to engage in price discrimination. To prove that Apple's exclusionary conduct increased its market power and thereby caused harm to competition one can use the same method to show that the degree of price discrimination increased when Apple introduced ITMS. Because harm to competition is also the damage to retail direct purchasers, this published article demonstrates the feasibility of the mark-up

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[3] Liability issues are discussed on 9-16 and 18-51 of the *Noll Report*.

[4] *Ibid*, p. 30.

[5] The article on iPod profit margins that was cited in the *Noll Report* has been published. Jason Dedrick, Kenneth L. Kraemer and Greg Linden, "Who Profits from Innovation in Global Value Chains?: A Study of the iPod and Notebook PCs," *Industrial and Corporate Change*, June 22, 2009, at http://icc.oxfordjournals.org/cgi/reprint/dtp032r1.

method for calculating dames in a manner that is common to class members who purchased an iPod directly from Apple.

The Similarity between the Noll Report and the French Report

The *Burtis Report* repeatedly states that the *Noll Report* and the *French Report* have the same content in that they propose the same methods, make the same arguments, and have the same flaws.[6] This claim is true in the following respect. The two reports define the same three methods for calculating damages – before-after, yardstick, and mark-up – and both contain discussions of how one of these methods, the before-after test, can be implemented.

This similarity is hardly surprising. These three methods are the standard approaches that economists normally use to calculate damages. The essence of every damage method is to estimate the price that would have arisen had the firm not enjoyed enhanced market power from anticompetitive conduct. In calculating the overcharge due to anticompetitive conduct, economists must find some form of competitive benchmark. Damage is then calculated by subtracting the competitive benchmark or "but-for" price from the price that was actually charged.[7] The method for establishing the but-for price is normally highly contested, with defendants arguing that the estimated but-for price is too low because the plaintiffs' procedures for estimating the but-for price ignore various

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[6] The *Burtis Report* describes the treatment of an issue by the two reports as the same or similar in paragraphs 8, 9, 10, 12, 13, 14, 18, 19, 22, 23, and 36.

[7] In their text book Professors Kip Viscusi, Joseph Harrington and John Vernon state the general principle: "Standard antitrust practice is to calculate damages... as the additional revenue on the units sold." W. Kip Viscusi, Joseph E. Harrington, Jr., and John M. Vernon, *Economics of Regulation and Antitrust*, 4th Edition, MIT Press, 2005, p. 145.

factors, just as Dr. Burtis does here. The problem here is that this dispute has an ethereal quality because neither economist has been given access to the data that would be used to produce a damage formula and then to attempt to show that it is invalid.

The before-after test, the yardstick or comparable product prices test, and the mark-up or excess margin test are described and widely accepted in scholarly writings in antitrust economics. Professors Roger Blair and David Kaserman devote a section of their text to damages calculation. They summarize the standard approaches in antitrust economics by stating that "the measure of damage is roughly equal to the wealth transferred to the monopolist from the buyers."[8] They list "three basic theories or how one goes about measuring... overcharges" as the "before and after theory," the "yardstick theory," and the "market share theory."[9] The last is only relevant to estimating the lost profits of a competitor that is harmed by anticompetitive conduct, so is not pertinent here. The "*yardstick approach* to damage estimation is based upon a comparison of the plaintiff's experience with that of a firm or market that was unaffected by the illegal activity... A plaintiff that is claiming damage due to overcharges may attempt to compare the prices it paid with those charged in similar markets where there was no antitrust violation." The comparable products test (called yardstick in the *Noll Report*) and the mark-up test are both included as yardstick methods by Professors Blair and Kaserman.

Dr. John Johnson also has written about damages.[10] Dr. Johnson states: "Several

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[8] Roger D. Blair and David L. Kaserman, *Antitrust Economics*, Richard D. Irwin, 1985, p. 78.

[9] *Ibid.,* pp. 78-79.

[10] John Johnson, "Economic Approaches to Antitrust Damage Estimation," NERA Economic Consulting, January 2005.

common models are frequently used in antitrust cases and have been accepted by courts under *Daubert* standards as a reliable approach to calculating damages."[11] The first he calls the "benchmark or straight-line model," which he then describes as the before-after test.[12] The second method he also calls the "yardstick model," which is the same yardstick test that I proposed here.[13]

Professor John Connor was asked by the Amsterdam Centre for Law and Economics to prepare a paper on "Forensic Economics in Competition Law and Policy."[14] In his paper, Professor Connor discusses damages methods. According to Professor Connor: "The principle challenge for forensic economists is to calculate the relative competitive benchmark price..."[15] He then goes on to describe the principle methods of calculating damages as the "before and after method" (which he dates to the 1920s), the "yardstick method" (which he notes has been used in cases involving bread, milk and construction services), the "cost-based approach," the "constant-margin approach" (which was used in the Vitamin E conspiracy), and the game theory method.[16] His yardstick approach is the same method that I call the yardstick method, and his constant-margin and game-theory approaches are the methods that I call the mark-up test.

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[11] *Ibid.,* p. 6.

[12] *Ibid.,* pp. 6-7.

[13] *Ibid.*, p. 7.

[14] John M. Connor, "Forensic Economics: An Introduction with Special Emphasis on Price Fixing," *Journal of Competition Law and Economics* Vol 4, No. 1 (March 2008), pp. 31-59.

[15] *Ibid.,* p. 45.

[16] *Ibid.,* pp. 46-53.

My personal experience provides further evidence that these methods are standard within the economics profession and in antitrust litigation. I have successfully proposed one or more of these methods for calculating damages in several class action antitrust cases dealing with products as diverse as luxury tableware,[17] dynamic random access memory (DRAM),[18] static random access memory (SRAM),[19] compact discs,[20] and repair and maintenance service for complex equipment such as high-speed photocopiers[21] and body imaging devices.[22]

One should not be surprised that these same methods were considered by the economic experts for both the direct and indirect purchaser classes in this litigation. Indeed, if our reports were not similar in this respect, at least one of us would not be proposing a method that enjoys widespread acceptance in antitrust economics and, therefore, would be vulnerable to a *Daubert* motion.

Beyond this, the *French Report* and the *Noll Report* do not analyze damage methods in the same way. One important difference is that I focus only on calculating the overcharge to direct purchasers. Because Dr. French is concerned with damages to indirect end-user purchasers of iPods, his analysis must prove that the overcharge to

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[17] *In Re: Tableware Antitrust Litigation*, U. S. District Court, San Francisco, California.

[18] *In Re: DRAM Antitrust Litigation*, U. S. District Court, San Francisco, California.

[19] *In Re Static Random Access Memory (SRAM) Litigation*, U. S. District Court, San Francisco.

[20] *Consolidated Compact Disc Antitrust Litigation*, U. S. District Court, Los Angeles, California.

[21] *R&D Business Systems v. Xerox*, U. S. District Court, Marshall, Texas.

[22] *Southeast Georgia Regional Medical Center vs. General Electric Corporation,* U. S. District Court, Brunswick, Georgia.

direct purchasers was passed on in the same fashion to all members of the indirect purchaser class. That is, Dr. French must first propose a method for calculating the overcharge to retail outlets and distributors that bought iPods, and then trace these overcharges through to the prices that were charged to consumers at retail.[23] Whereas the calculation of overcharges to direct purchasers makes use of Apple's transactions data, the calculation of pass-through to indirect purchasers requires analyzing retail prices for iPods at a variety of retail outlets, based on sales records that must be discovered from third parties. Pass-through analysis is a substantial undertaking that I do not have to face.

Notwithstanding the differences in the scope of the damage analysis that is required in the two cases, the *Noll Report* is substantially more detailed in discussing just the overcharge to direct purchasers than the *French Report* in discussing both the direct overcharge and the pass-thorough analysis. The entire discussion of damages methods in the *French Report* is four pages long.[24] Moreover, after defining the general approach that economists use to calculate damages and the three methods discussed above, Dr. French narrows his discussion to two versions of the before-after method. One combines a before-after test on Apple's wholesale prices to retailers and distributors and a pass-through analysis, and is explained in two pages.[25] The other, which is explained in a single page,[26] is a before-after test on retail prices. The only similarity between the two reports is that we have substantially overlapping descriptions of the general form of a

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[23] *French Report*, p. 34.

[24] *Ibid.*, pp. 34-8.

[25] *Ibid.*, pp. 35-7.

[26] *Ibid.*, p. 37.

price regression that would be used to estimate the overcharge to direct purchasers. Finally, Dr. French describes the data he needs and where he can obtain them in two additional paragraphs.[27]

The *Noll Report* discussion of damages methods is twice as long as the damages section of the *French Report*.[28] Moreover, contrary to the statement in the *Burtis Report* that "Dr. French proposed the same three basic approaches" to damage calculation,[29] the *French Report* did not propose either the yardstick method or the mark-up method. Dr. French devoted exactly one sentence to describing each of these methods[30] before moving on to focus his analysis on the before-after method. Dr. Burtis is incorrect when she states that "Professor Noll's proposed methods suffer from the same flaws that the Court found in Dr. French's three methods."[31] Her report for the indirect purchaser case asserts: "Dr. French states that he intends to use a 'temporal competitive benchmark'" (or before-after) method.[32] Nowhere in her first expert report does she mention the yardstick and mark-up methods. This omission makes perfect sense because Dr. French neither analyzed nor proposed them. Thus, neither Dr. Burtis nor the Court found flaws in Dr. French's proposed yardstick and mark-up methods because the *French Report* did not propose them.

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[27] *Ibid.*, pp. 37-8.

[28] *Noll Report*, pp. 51-8.

[29] *Burtis Report*, p. 3.

[30] *French Report*, p. 35.

[31] *Burtis Report*, p. 3.

[32] *Expert Report of Dr. Michelle M. Burtis*, *Somers v. Apple, Inc.,* p. 8.

Another important difference between the *French Report* and the *Noll Report* is that the methods that I proposed were based on individual observations of transactions prices. Dr. French proposed averaging prices for both months and models of iPods. Dr. Burtis found the use of average prices to be sufficiently important that in the indirect purchaser case she devoted three pages of her 18 page report to this issue.[33]

Data and Equations

Dr. Burtis criticizes the *Noll Report* for not implementing the methods that were proposed. The *Burtis Report* states that I did not collect any data, show that data exist to implement my methods, identify or quantify the specific variables that would be used to calculate damages, and write down any equations.[34] I disagree with Dr. Burtis on two grounds. First, my report does not lack specificity about the variables and data that would be used to estimate damages. Second, I disagree that it is reasonable or even possible to show the equation that will be used to calculate damages and to prove that estimating that equation is feasible before discovery of transaction records, costs and documents pertaining to price policies is complete.

As explained in the *Noll Report*, all methods for calculating damages are based on comparing actual and but-for prices.[35] The *Noll Report* states that economists take technological change into account in a price regression that is used to calculate damages by incorporating measures of qualitative features, input costs, and the stage of a product's

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[33] *Ibid.*, pp. 16-18.

[34] *Burtis Report*, p. 3.

[35] *Ibid.,* p. 50.

life-cycle.[36] The *Noll Report* also discusses how published research has constructed input price data to estimate the excess margin on the iPod[37] and that the information in Apple's financial reports and discovery documents shows that the defendant collects data on costs and margins by product line.[38] In addition, the *Noll Report* states that the number of recordings that are available on ITMS should be taken into account in a price equation.[39] In addition, the *Noll Report* explains how transactions data, data on revenues and costs by product line, and documents pertaining to pricing policies can be used to inform the implementation of a method to calculate damages, and notes that these data are available from the defendant as well as other manufacturers of portable digital media players.[40]

The *Noll Report* does not write down an equation because doing so before the data are available is uninformative. Until one has access to data, one does not know what variables are going to prove to be statistically significant in a regression analysis. Dr. Burtis explained that, among approximately 30 alternative equations that were considered in estimating the effect of Hurricane Katrina on the profitability of oil refineries, the specification that was used was the one that best fit the data.[41] She also testified that she was aware of my expert report in the flash memory case, in which I estimated a price

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[36] *Ibid.*, p. 54.

[37] Dedrick, *et al., op. cit.*

[38] *Noll Report*, pp. 29-30.

[39] *Ibid*, p. 54.

[40] *Ibid.*, pp. 51-2, 54, 57-9.

[41] *Burtis Deposition*, pp. 69-70.

equation based on the product characteristics of flash memory.[42] Flash memory also undergoes rapid technological progress due to learning by doing[43] and Moore's Law.[44] In addition to capacity improvements, nine other separate dimensions of product attributes are distinguished in flash product codes, each of which is subject to technological innovation.[45] Yet in the price regression for flash memory, only a few of attributes significantly affected product prices.

For iPods, some product characteristics are certain to be important in explaining price differences among models because they have a substantial effect on manufacturing cost: memory capacity, video capability, and Internet access. Until regressions are run, one cannot know whether production cost alone is sufficient as a measure of product attributes,[46] or whether additional explanatory power can be obtained in a price regression by including variables that measure the presence of technical characteristics.[47] In addition, whether all or only some product characteristics are important in determining price is unclear on *a priori* grounds. Until one has the data, one does not know which

[42] *Ibid.,* pp. 63-5.

[43] Learning by doing refers to a characteristic of semiconductor manufacturing whereby the cost per unit of output falls as output increases. The source of learning by doing is improvements in the manufacturing process that reduce the proportion of defective chips and wasted silicon. This phenomenon is relevant to this case because semiconductors are an important component of iPods and account for a substantial share of iPod costs.

[44] Moore's Law states that the capacity of a semiconductor of a given physical size falls in half every 18-24 months. The period is even shorter, roughly 12 months, for flash.

[45] For example, during the class period in the flash case, multi-level memory cells were introduced and widely adopted as replacements for single-level cells.

[46] All features may be like memory, as discussed above, in that additional component costs are simply doubled in the retail price.

[47] The issue of equation specification is discussed in greater detail in the section on the before-after method of calculating damages.

specification will best explain the data.

Because of the impossibility of specifying a regression model prior to having access to data, the *Burtis Report* establishes a standard for an economic expert report in support of class certification that is impossible to meet. One can never prove which equation will best fit the data without having access to the data. In this case the necessary data are transactions records by product model number and information about the product models, none of which have yet been produced by the defendant. Without this information one can not write down an estimating equation and show that it will work.

Coolness

Dr. Burtis states that I acknowledge that "purchasers' attachments to iPods and 'coolness'" affect the demand for iPods, but that I do not "propose any specific method for measuring them."[48] Notwithstanding that I do not agree with this characterization of my testimony, Dr. Burtis provides absolutely no evidence that "coolness" has any importance in calculating the damages arising from the alleged exclusionary conduct of the defendant. In her deposition, Dr. Burtis asserted that damage calculation is unusually difficult because "people buy iPods because they are cool."[49] She then testified she does not know when iPods became cool, why they are cool, or how to measure coolness, but she also claims to know that iPods are cooler today than they were in 2001.[50]

The Dutch market researcher Dr. Carl Rohde, a cultural anthropologist, has

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[48] *Burtis Report*, p. 7.

[49] *Burtis Deposition*, p. 103

[50] *Ibid.*, pp. 103-4, 198.

proposed both a definition and a method of measuring "coolness." Dr. Rohde's firm Signs of the Time and the public relations firm Hill and Knowlton conduct an annual "Global Cool Hunt" in which over 200 "cool hunters" worldwide identify "cool people, places, products, brands and symbols."[51] The purpose is to gather "information, insights and images that represent the mood and mentality of young people."[52] In short, "cool" is about appealing to young people, and is measured by how many global cool hunters identify something as cool.

In the chapter of the *Global Cool Hunt* that deals with high-tech products, the prime example is Apple. "Firstly, the Apple iPod is considered cool all over the globe. Right now it provides a superior way to take all the music you want with you all the time. And the design is great. Secondly, Apple computers are mentioned frequently, not least because of their creative design and because Apple offers its computers to consumers in many colours, giving them a wider visual choice, an area where everyone has strong immediate beliefs and preferences. In that sense, Apple offers a superior opportunity to its customers for an appealing colourful personalization of their computers. Which is cool – and totally in tune with the mentality trend Cool Personalisation…"[53] In short, "coolness" is a characteristic of Apple in general, and applies to computers as well as iPods. (This was written before the introduction of iPhones.) Coolness is derived from both attractive and functional design, and is measured by commissioning 200 plus young adults to list what they think is cool and why.

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[51] *Global Cool Hunt 2003/04*, Hill and Knowlton, undated, accessed October 9, 2009, at http://www.signsofthetime.nl/image/globalcoolhuntfinal.pdf, p. 3.

[52] *Ibid.*, p. 1.

[53] *Ibid.*, p. 12.

In *The Perfect Thing*, a commercial book devoted to identifying the sources of iPod's success, an entire chapter is titled "Cool."[54] After citing the designer of the Global Cool Hunt, Dr. Rohde, the author declares that "the iPod is the coolest thing in the world, a fact that in itself isn't so illuminating."[55] The chapter reports conversations between the author and Bill Gates, the founder of Microsoft, about whether coolness is just another word for successful in the market, and concludes that "coolness is not necessarily tied to profits." Examples of cool are "rock bands universally revered by trend makers (like the Velvet Underground in their heyday) but with sales that didn't track to their heady reputation." Cool is not about success in the marketplace, and hence cannot be confused with market power that is derived from anticompetitive conduct.

The Perfect Thing also reports a conversation between the author and Apple CEO Steve Jobs about why Apple products are cool. According to Jobs, "the thing that all of our competitors are missing is that they think it is about fashion, they think this is about surface appearance. They couldn't be further from the truth."[56] Functionality and ease of use – the attributes of a product – are the sources of cool. The only scholarly study I have found about the source of the popularity of the iPod reaches a similar conclusion. Based on an Internet survey of German iPod users, the study concluded that the ease of use of the control elements (click wheel, software, menu, dock connector) were the key design features responsible for iPod's success.[57]

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[54] Steven Levy, *The Perfect Thing: How the iPod Shuffles Commerce, Culture, and Coolness*, Simon & Schuster, 2006, pp. 75-106.

[55] *Ibid.*, p. 75.

[56] *Ibid.*, p. 95.

[57] Alexander E. Reppel, Isabelle Szmigin, and Thorsten Gruber, "The iPod Phenomenon:

Apparently Apple has been cool for a long time. Before its initial release, a mostly favorable review stated that "the iPod is a pretty cool contraption."[58] Another review at about the same time predicted that the iPod would be a win for Apple because: "It's that cool."[59] These are but a few examples. A Google News search on "iPod cool" for calendar 2001 turned up dozens of articles that extol the coolness of the product, beginning with its release in 2001 and long before the class period.

A final useful question is whether there is evidence to support the claim that iPods have grown cooler with the passage of time. Product reviews do not support Dr. Burtis's assertion to this effect. An article from 2005 notes that President George W. Bush uses an iPod and asks "How uncool is that?"[60] A year later an article observes that "fears are rising" that the iPod has become "too common to be cutting edge."[61] A marketing publication that examines the iPod and Puma athletic states that maintaining a cool image is difficult because an essential ingredient of coolness is the perception of exclusivity, which conflicts with obtaining high sales volume. The article concludes that to "stay

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Identifying a Market Leader's Secrets through Qualitative Market Research," *Journal of Product and Brand Management* Vol. 15, No. 4 (2006), pp. 239-49.

[58] Henry Norr, "Apple iPod Has Its Charms," *San Francisco Chronicle*, October 29, 2001, at http://www.sfgate.com/cgi-bin/article.cgi?file=/chronicle/archive/2001/10/29/BU215879.DTL&type=business.

[59] Charles Haddad, "Sweet Music from iPod," *Business Week*, October 31, 2001, at http://www.businessweek.com/bwdaily/dnflash/oct2001/nf20011031_4266.htm.

[60] Ken Belson, "Wireless: What Can Apple Do to Keep the iPod Cool?" *New York Times*, May 9, 2005, at http://www.nytimes.com/2005/05/08/technology/08iht-wireless09.html.

[61] David Smith, "Why the iPod is Losing Its Cool," *The Observer* September 10, 2006, at http://www.guardian.co.uk/technology/2006/sep/10/news.theobserver1.

cool" a firm must innovate, as Apple has done by continually introducing new iPods.[62]

Given that Apple products are commonly referenced as cool and that Apple's CEO has been interviewed about the source of coolness, the obvious next step is to learn through discovery the role of coolness in Apple's marketing and product planning. Does Apple have business relationships with the firms that conduct the Global Cool Hunt? Do internal documents take the coolness scores of their products seriously? Do they make use of the results from the Global Cool Hunt in either marketing their products or adding new design features? Dr. Burtis could have asked these questions of Apple and determined whether there was any relevant evidence before asserting that the coolness of the iPod was of rising importance in explaining iPod sales.

My review of publications about the coolness of iPods leads me to conclude that there is no evidentiary basis for taking coolness seriously in a damage analysis. An important lesson from reading the generally shallow material about coolness is that there is no reason to believe that the coolness of iPods has increased, in which case there is no danger that the effects of the alleged anticompetitive conduct are likely to be confounded with an increase in the attachment of consumers to the product. The many publications that mention the coolness of iPods show that iPods always were regarded as "cool" and that coolness, because it is associated with youthful trendiness, is something that a firm must struggle to maintain once a product is widely adopted. The damage from the alleged exclusionary conduct is measured as an increase in prices during the class period. If the iPod's coolness was established long before this date, and if the company had to struggle to maintain its iconic status, then there is no danger that the damages methods

[62] Eric M. Olson, Andrew J. Czaplewski, and Stanley F. Slater, "Stay Cool," *Marketing Management* Vol. 14, No. 5 (September/October 2005), pp. 14-17.

that I propose will falsely attribute profits from coolness, assuming that they exist, to profits from anticompetitive conduct.

Net Damages

Dr. Burtis states that my damage methods "do not consider the overall effect or net injury to individual proposed class members."[63] Dr. Burtis asserts that "the demand for and price of iTS music would have decreased" as a result of the alleged exclusionary behavior, and that "to determine whether any consumer paid a **net** overcharge would require an analysis of both the prices of iPod products and the price of iTS music."[64]

This section of the *Burtis Report* is free of any citations to sources in law and/or economics to support the proposition that the proper way to calculate damages in an exclusionary conduct case is the net effect of price changes in two markets – the market in which exclusionary harm took place, and the monopolized market that gave a firm the market power to exclude competitors in the other market. Nothing I have ever read in antitrust economics has ever proposed that damages be netted in this way. Moreover, in other antitrust cases that allege exclusionary behavior no such netting exercise took place. Examples are the class actions against Microsoft over its exclusionary behavior with respect to middleware and applications software and against Kodak and Xerox about tying the sale of parts to the sale of repair services for high-speed photocopiers. The damage calculation in the Microsoft case did not net out any benefit consumers received from the zero price for Internet Explorer, and the damage calculations in the third-party

[63] *Burtis Report*, p. 15.

[64] *Ibid.*, p. 16.

maintenance cases did not subtract a reduction in parts prices and photocopiers from the overcharge for service.

A necessary condition for Dr. Burtis's proposed netting method to make sense is that the effect she asserts – ITMS prices were lower because of the alleged exclusionary conduct – actually is true. Before asserting that an offsetting price change occurred, the first step is to check the agreements between Apple and the record companies about prices. The price of downloads may have been part of the contractual agreements between Apple and the record companies. Without discovery of these contracts, one does not know whether Apple was free to adjust prices in response to shifts in demand.

As a matter of economic analysis, Dr. Burtis's assertion about compensating price changes is incorrect. Dr. Burtis did not cite any publications in economics to support the assertion that ITMS prices would be lower if Apple engaged in exclusionary behavior in the market for portable digital media players. In economic theory the effect of exclusionary behavior in the market for portable digital media players on ITMS prices is uncertain. Prices for music downloads could go up, down, or stay the same. The reason for this ambiguity is that the shift in demand for ITMS that is noted by Dr. Burtis is not the only effect. Exclusionary behavior in the market for portable digital media players reduces competition among digital download sites, which makes the demand for ITMS downloads less price-sensitive.

Professor Michael Riordan examines a case that is similar to the iPod-ITMS circumstance. In his analysis a dominant firm with a superior technology (like iPods) and a first-mover advantage in both markets (like iPods and ITMS) engages in backwards vertical integration (starts ITMS), and shows that in this circumstance prices increase for

both products.[65] Whereas Dr. Burtis and I can argue about whether Professor Riordan's theoretical model is a reasonable approximation to the facts in this case, the point is that Dr. Burtis's claim that exclusionary behavior must lead to a price decline in the monopoly market is simply not correct.

Notwithstanding that Dr. Burtis has no basis for claiming that there is any offsetting effect in the market for downloads, her netting out proposal cannot possibly apply to all members of the direct purchaser class. Also in the direct purchaser class are retail stores and wholesale distributors. These direct purchasers do not buy music from ITMS, and so could not possibly have experienced any compensating benefit.

DAMAGES METHODS

Dr. Burtis argues that none of the methods for calculating damages will work. The preceding section discusses the general arguments in the *Burtis Report* that apply to all three methods. This section discusses Dr. Burtis's specific claims about each method.

Before-After

The before-after method compares the prices of products during the period when alleged anticompetitive conduct affected the product with prices in periods when the anticompetitive conduct had no effect.[66] In this case, the product at issue – the iPod – is an example of a differentiated product, which means that the product is available in

[65] Michael H. Riordan, "Anticompetitive Vertical Integration by a Dominant Firm," *American Economic Review* Vol. 88, No. 5 (December 1998), pp. 1232-48.

[66] This paragraph briefly summarizes the before-after method, as described in the *Noll Report* (pp. 54-5) and the *Burtis Report* (p. 5-6).

several different models with different characteristics. A common approach to implementing the before-after method is to use regression analysis. The dependent variable in the analysis normally is price or the logarithm of price, which can be measured either for each transaction or, if the product is only sold at a posted price, the list price. The independent variables include measures of cost, measures of demand, and, in differentiated product industries, product attributes that might affect demand. If the seller grants quantity discounts and/or negotiates long-term supply contracts, other features of the transaction that affect price (quantity, duration of the contract, and advance quantity commitments) also are included in the regression.

Formulating the Model

Dr. Burtis and I apparently agree that the first step in applying this method is to think about the variables that might be significant in the price regression. Whereas one knows in advance that production cost and qualitative attributes might prove to be statistically significant and quantitatively important in explaining price, one does not know in advance which specific variables will prove to be important. For example, production cost is affected by the inputs that determine product features, so that variation in price may be explained by cost without also using measures of product attributes. If two models are close substitutes, product attributes are unlikely to affect prices other than through cost because the substitutability of the products will force the seller to charge roughly the same mark-up for both. If models are not close substitutes, the amount of excess profit that a firm earns may differ among products so that cost is insufficient to explain price differences among models.

Once one knows which variables might be important, the next step is to gather the data. As discussed in the previous section, the before-after test that I proposed is based on transactions data, so to implement it plaintiffs need to discover transactions records (model number, price, quantity, date), long-term contracts with distributors and retail chains, and internal documents pertaining to price policies and to negotiations with customers. Dr. Burtis states that "Apple's pricing strategies may be more complex than the model envisioned by Professor Noll."[67] This statement could not state more clearly why no competent economist would specify the regression model prior to discovery that would reveal the nature of these pricing policies.

Plaintiffs also need data relating to independent variables in the regression, such as cost, components, and features that vary among models, such as size, weight, video display, and Internet access. Data to measure market supply and demand conditions can be collected from public sources. Examples are total sales in the market, the entry of a new competitive product that is favorably reviewed, and the inventory of recordings on ITMS and the largest alternative legal Internet download store. As with the variables measuring qualitative attributes, these variables may not be necessary. A common method to take into account changes in market conditions is to use a separate indicator variable for each time period (usually a month or a quarter).

The third step is to estimate the regression model. Dr. Burtis states that the before-after test is implemented by creating a "dummy variable" (by which she means an indicator variable) which takes the value one during the period in which exclusionary

[67] *Burtis Report,* p. 7.

conduct took place and is zero during other periods.[68] This description is incomplete, and its excessive simplicity explains Dr. Burtis's puzzlement over my failure to commit to a particular method for measuring the effect of the defendant's alleged exclusionary conduct.[69] If one believes that the effect of exclusionary conduct differed over time, one can test whether a variable effect was present in two ways. The first is to create more than one indicator variable for the period in which exclusionary conduct took place.[70] The second is to find a quantitative measure of the incremental market power that was created by the exclusionary effect.[71] In some cases, the indicator variable can be interacted with other independent variables to measure the differential effect of the exclusionary conduct.[72]

In all of these circumstances, the precise specification of how the period of anticompetitive conduct is entered into the regression model depends on the perceptions

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[68] *Ibid.*, pp. 5-6.

[69] *Ibid.*, p. 6, citing *Noll Deposition*, p. 198.

[70] For example, in a price-fixing case documentary evidence may show that periodically the cartel agreement broke down and the conspirators engaged in a price war until a new agreement could be forged. The effect of the price war can be calculated by creating a separate indicator variable for the price war period. A classic example of this type of analysis pertains to periodic price wars among colluding railroads. See Robert H. Porter, "A Study of Cartel Stability: The Joint Executive Committee, 1880-1886," *Bell Journal of Economics* Vol. 14, No. 2 (Autumn 1983), pp. 301-14.

[71] For example, exclusionary conduct may only gradually drive competitors from the market, in which case the market share of the defendant or the Herfindahl-Hirschman Index of concentration may be a better measure for capturing the effect of exclusionary conduct.

[72] For example, exclusionary conduct may enable a firm to practice greater price discrimination against some types of buyers, which can be captured by interacting the indicator variable for the present of anticompetitive conduct with another indicator variable for a particular type of buyer, such as retail chain stores.

of the defendant about its position in the market and the defendant's pricing policies, both of which are informed by discovery. For this reason, writing down a regression and testing its feasibility prior to discovery can lead to misleading results, even if transactions data are made available. To provide a concrete example, in my analysis of the DRAM price-fixing cartel, evidence obtained in discovery indicated that the cartel fell apart for several months during the class period. We tested whether the cartel broke down by creating a separate indicator variable for this period, and found that prices during this period were not statistically significantly different from the periods before and after the cartel was in operation.

A similar problem arises with respect to independent variables. Whereas iPods differ according to several technical characteristics, until one runs the regressions one does not know which variables will be statistically significant in explaining variations in prices. Moreover, until one runs regressions, one does not know which method of measuring an independent variable does the best job of explaining price variation. For example, consider the memory capacity of an iPod. Among models currently available on the Apple website, memory capacity varies from 2GB to 64GB. One way to measure memory is as a continuous variable in gigabytes (2, 4, 8, etc.). Another way is a series of indicator variables, one for each specific capacity. Still another way is the actual input cost of memory for each model. Only by trying each measure, plus both size and cost together, can one know which specification is going to do the best job explaining price variation among iPod models.

Dr. Burtis's critique goes beyond the claim that I ought to have specified the regression I would run – the variables that would be included and the way each would be

measured. Dr. Burtis states that she "is not aware of any valid before-after regression method that could determine damages given the realities of the varying products" and "the relatively few price changes in the products over time."[73] The "realities" to which she refers are the fact that iPods, with varying technical characteristics have been sold by Apple for eight years, most of which were not sold during the year and a half period before the alleged exclusionary conduct began.

Dr. Burtis offers two related arguments as the basis for her belief that the before-after method can not be implemented. One is omitted variables, and the other is the stability of the relationship between supply and demand factors, both of which, according to Dr. Burtis, are present here.[74]

Omitted Variables

The omitted variables problem can occur if some variables that have a substantial effect on price are excluded from a regression. Of course, in this case no regression can be run yet because no data have been produced, so that there is no basis for claiming that any potentially important variable has been omitted. Notwithstanding the fact that no one can yet know that an omitted variable problem exists in this matter, if important causal variables were omitted the estimated effect of the variables that are included may be incorrect. Dr. Burtis states the problem in the following way.

> "To obtain a robust and accurate measure of any alleged overcharge, a regression model must be able to account for all of the important factors relevant to determining iPod

[73] *Burtis Report*, p. 6.

[74] *Ibid.,* pp. 6-7.

prices. Otherwise, it has no probative value."[75]

Dr. Burtis substantially overstates her case for four reasons.

First, all regressions are likely to have omitted variables – that is, no economist is likely to identify and to measure every conceivable factor that might influence a dependent variable. Indeed, even a near-perfect regression that explains nearly all of the variance in the independent variable may still have a biased coefficient because one explanatory that is correlated with another also has a causal effect on the dependent variable. As one text puts it, "we can never slay the omitted variable dragon… Every additional control may improve our study, but we are never immune to the charge that yet another subtle hidden variable has not been accounted for."[76] For this reason, the proper response to an assertion that some variable is excluded that might be important is that the critic should prove it.

Second, as explicitly stated in the source that she cites, a book by Daniel Rubinfeld about the use of econometrics in antitrust, the coefficient on the variable that measures the presence of anticompetitive conduct is biased only if that variable is correlated with an excluded variable. If the omitted variable is not correlated with the measures that are used for the period of anticompetitive conduct, its exclusion will have no effect on the damages that are calculated from the regression model. The only effect will be to reduce the explanatory power of the regression. In damage analysis the objective is to provide an accurate, efficient estimate of the overcharge, not to do the best conceivable job of modeling supply and demand for iPods.

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[75] *Ibid.*, p. 6.

[76] Humberto Barretto and Frank M. Howland, *Introductory Econometrics Using Monte Carlo Simulation with Microsoft Excel*, Cambridge University Press, 2006, p. 492.

Third, the bias that occurs if the omitted variable is correlated with an included variable can be positive or negative. Coefficients on included variables can be either too high or too low, depending on whether the correlation between an included and excluded variable is positive or negative and whether both variables have the same or opposite effects on price. An omitted variable is as likely to lead to an underestimate of damages as it is to lead to an over-estimate.

Fourth, the solution to an omitted variable problem is to add more independent variables. Even if an important variable cannot be incorporated into a regression because it is not observable, its effects sometimes can be detected indirectly by "a signature technique"[77] in econometrics called instrumental variables.[78] This procedure uses variables that are correlated with the omitted variable but not with the included variables as substitutes for the omitted variable. A common technique is to use indicator variables for time periods as instruments for unmeasured but changing supply and demand factors. For example, suppose one seeks to explain variation in umbrella prices. Rainfall may affect the pattern of umbrella sales during the year. One might include monthly rainfall data for every county in the nation in a regression to explain the price of umbrellas, or

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[77] Joshua D. Angrist and Alan B. Krueger, "Instrumental Variables and the Search for Identification: From Supply and Demand to Natural Experiments,"*Journal of Economic Perspectives* Vol. 15, No. 4 (Fall 2001), pp. 69-85 at 69.

[78] See, for example, J. D. Sargan, "The Estimation of Economic Relationships Using Instrumental Variables" *Econometrica* Vol. 28, No. 3 (July 1958), pp. 393-415; Douglas Staiger and James H. Stock, "Instrumental Variable Regressions with Weak Instruments," *Econometrica* Vol. 65, No. 3 (May 1997), pp. 557-86; and Joshua D. Angrist, Guido W. Imbens, Donald B. Rubin, "Identification of Causal Effects Using Instrumental Variables," *Journal of the American Statistical Association* Vol. 91, No. 434 (June 1996), pp. 444-55.

one might instead simply enter indicator variables for each month of the year, knowing that this variable will pick up differences in demand owing to differences in total rainfall during the course of the year. A standard practice in applied econometrics is to include groups of indicator variables to protect against the possibility that an omitted variable is biasing the regression.

Suppose one made the econometric error of excluding the memory capacity of an iPod from the price regression, and suppose that memory capacity is generally increasing over time. Then the coefficient on the indicator variable for the exclusionary period will pick up the effect on price of the differences in average memory capacities of iPods in the before and during periods. If memory also is increasingly expensive over time so that the higher cost of memory is passed through in the price of an iPod, a positive correlation will exist between the exclusionary conduct and the effect of memory on price, leading to an over-estimate of damages. But suppose instead that, owing to Moore's Law and learning by doing, the price of memory is falling so fast that more memory this year is cheaper than less memory last year. In this case, exclusion of the memory variable will cause the indicator for exclusionary conduct to pick up the effect on prices of the difference in average memory cost between the before and during periods. Because the effect of declining memory cost is to cause lower prices, the estimated effect of exclusionary conduct will be biased downward.

The effects of memory on price can be taken into account by putting two variables into the regression. The first is the memory capacity of the iPod, and the second is the price of the flash memory chip that Apple used in the iPod. The first is clearly observable. But suppose that a fire has destroyed Apple's records of the price it paid for

flash memory, and an earthquake has destroyed the transactions records of Toshiba regarding their sales of flash memory to Apple. All is not lost if a proper instrument can be found. For example, *DRAM Exchange* publishes average prices for various memory chips. The average price for all flash memory of the appropriate capacity is not the actual price that Apple paid to Toshiba, but it is likely to be a good instrument.

The important lessons to be drawn from the preceding discussion of omitted variables are as follows. First, the existence, nature and extent of the omitted variable problem in a price regression that would be used to calculate damages in this case can not be known, much less proved, until data are discovered and regressions are run. Second, the circumstance to be feared is one in which a variable that is not observable is positively correlated with both the variable that measures the presence of anticompetitive conduct and the price of iPods, but even this problem usually can be solved by using instrumental variables.

Instability in Supply and Demand

The *Burtis Report* is not clear about the nature of the instability in supply and demand relationships that affect the market for portable digital media players. Dr. Burtis states that the before-after method assumes "that price reacts similarly to cost changes, or demand changes, in both the 'before' and 'after' periods."[79] As written, this statement does not make economic sense. If one has measured cost and the factors that affect demand, the only remaining factor that could affect price is a change in market power on either side of the market. Thus, I assume that Dr. Burtis is actually saying that certain

[79] *Burtis Report*, p. 7.

factors that affect cost and demand necessarily must be omitted from any price regression that would be used to calculate damages. I believe that this is the only interpretation of this statement that is economically meaningful.

Dr. Burtis lists many characteristics of an iPod as likely to affect supply (by which I assume she means cost) and demand: capacity, weight, size, design, screen-size, video and photo display, battery life, color, operating system, software capabilities, and others in Exhibit D of her report.[80] She then states that I have failed to prove that data exist to measure these factors. The implication of this statement is that Apple does not know or cannot produce in discovery the specifications for its own products. Even if a tsunami has destroyed Apple's records, all is not lost. Plaintiffs can buy each of the 43 models of iPods and examine their features and components. Or plaintiffs can follow the lead of an article that is cited in the *Noll Report* by consulting an industry trade source that issues teardown reports of the components of consumer electronics products.[81] Or plaintiffs can consult publications that contain product reviews having extensive information about technical features, such as CNet.[82]

While the claim that data about model features for iPods are unavailable is clearly incorrect, Dr. Burtis also expresses doubt about whether a valid price regression can be estimated. Dr. Burtis gives two reasons.[83] First, Dr. Burtis argues that many new

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[80] *Ibid.*

[81] Dedrick, *et al., op. cit.*, p. 7, reports that their study was based on teardown reports from the 2005 Portelligent report on two 30GB models of iPod, one with and one without video capability.

[82] See an index of CNet reviews at http://www.cnet.com/ipod/.

[83] *Burtis Report*, pp. 8-10.

versions of iPods have been introduced since April 2003, and that these models incorporate features that were not available before the class period began. Second, the before period is roughly 18 months in comparison with the class period, which begins in April 2003 and continued to at least the time my report was written five years later.

The *Burtis Report* does not actually state that estimating a valid and reliable price regression is not feasible. Instead, the *Burtis Report* only states that I have not shown that a price regression of the form that I propose will work and that to make it work requires overcoming a series of problems. In her deposition, when asked whether she believes that a valid before-after test is impossible in an industry in which products are changing rapidly, she stated that "it depends," followed by the same statement that I had not shown it would work here,[84] but later she stated that "if you have characteristics of products that exist in only one of the two periods, then the result that you would get… could not distinguish the effect of the before and after period from the effect of that characteristic that was added."[85] This statement is simply incorrect as a matter of econometric methodology.

Product characteristics are one factor that can shift cost and demand, and generally incorporating measures of these features into the regression causes no problem in estimating the effect of some event, whether it is the instigation of anticompetitive conduct or Hurricane Katrina. Dr. Burtis's claim is correct only if the measure of anticompetitive conduct is nearly perfectly correlated with the measure of product features, which would occur if a very important feature of the iPod can be measured only

[84] *Burtis Deposition*, pp. 57-8.

[85] *Ibid.*, pp. 61-2.

as an indicator variable (present or not present), the period of exclusionary conduct also can be measured only as an indicator variable, and both variables take the value of one during approximately the same time period. In examining the features of the iPod that have been introduced since April 2003, I am not aware of any that were introduced around that date and have remained unchanged since that time. If there is not near-perfect overlap between the measure of an important feature and the measure of the exclusionary conduct, Dr. Burtis's claim is incorrect.

In fact, contrary to Dr. Burtis's testimony in her deposition, economists often estimate the value of new product features using the same underlying price regression that I proposed in the before-after test. A price regression in which product characteristics are used as independent variables is called a hedonic regression. Hedonic regressions are widely used in economics to analyze differentiated products, especially with frequent product innovation, including markets for consumer electronics.[86] Two recent examples use hedonic regressions to analyze prices for mobile telephones, including devices that include a portable digital media player.[87] These articles

[86] See Ernst R. Berndt, "The Measurement of Quality Change," Ch. 4 of *The Practice of Econometrics: Classic and Contemporary*, Addison-Wesley, 1991; Ariel Pakes, "A Reconsideration of Hedonic Price Indices with an Application to PCs," *American Economic Review* Vol. 93, No. 5 (December 2003), pp. 1578-96; Patrick Bajari and Lanier Benkard, "Demand Estimation with Heterogeneous Consumers and Unobserved Product Characteristics: A Hedonic Approach," *Journal of Political Economy* Vol. 113, No. 6 (December 2005), pp. 1239-76; and Paul D. Chwelos, Ernst R. Berndt, and Iain M. Cockburn, "Faster, Smaller, Cheaper: A Hedonic Price Analysis of PDAs," *Applied Economics* Vol. 40, No. 22 (November 2008), pp. 2839-56.

[87] Rolf Dewenter, Justus Haucup, Ricardo Luther and Peter Rotzel, "Hedonic Prices in the German Market for Mobile Phones," *Telecommunications Policy* Vol. 31, No. 1 (2007), pp. 4-13, and Naoki Watanabe, Ryo Nakajima, and Takanori Ida, "Quality-Adjusted Prices of Mobile Phone Handsets and Carriers' Product Strategies: The Japanese Case," Discussion Paper No. 1224, Department of Social Systems Management, University of Tsukuba, January 2009.

demonstrate that a hedonic price regression is highly likely to be feasible in this case because it has worked for consumer electronics products that have similar complexity and even overlapping functionality when compared with iPods.

Katrina Study as Benchmark for Damage Analysis

Dr. Burtis refers to her article on the effects of Hurricane Katrina on oil refineries, stating that she was able to perform a before-after test because she had sufficient data to forecast but-for prices in the aftermath of the hurricane.[88] I have read this article, and I regard it as competently executed, but the methods that are used in that article do not satisfy the standards for a valid damage method that are set forth in the *Burtis Report*.

The purpose of Dr. Burtis's article is to quantify the price spike that occurred after Katrina disabled the Gulf Coast oil industry. In the absence of Katrina, the price spike would not have occurred, so Dr. Burtis and her co-authors assume that the appropriate measure of loss to a disabled refinery is the revenue it would have received had Katrina and the price spike not occurred. The usefulness of the Katrina study as a damage analysis hinges on this assumption, rather than the alternative assumption that for any given refinery, the appropriate assumption is that Katrina occurred and damaged many refineries, but the particular refinery in question was spared rather than disabled.

One can convert the problem of identifying damages due to Katrina into a hypothetical antitrust damages example by assuming that the cause of the price spike was a very short-lived cartel of oil refineries that adopted a policy of output curtailment equal

[88] *Burtis Report*, p. 2. The study she discusses is Kivanc Kirgiz, Michelle Burtis, and David A. Lunin, "Petroleum-Refining Industry Business Interruption Losses Due to Hurricane Katrina," *Journal of Business Valuation and Economic Loss Analysis* Vol. 4, No. 2 (2009), no pages (available online only from Berkeley Electronic Press).

to the production that was lost due to Katrina. The study by Dr. Burtis and her co-authors represents a method for calculating the but-for price that would have arisen had the cartel never been organized, and the damage to hypothetical direct purchasers of refinery products is the difference between the actual price and the but-for price during the price spike period multiplied by the quantity of refined products that were purchased during the hypothetical cartel period. Restating the Katrina paper as an exercise in a damage analysis in a hypothetical antitrust case is useful because it highlights the implications of using this paper as a standard for antitrust damages analysis.

The data that were used in the regression model that Dr. Burtis estimated in the Katrina study used weekly gasoline inventory and weekly average prices for crude oil, gasoline and heating oil. In the indirect purchaser case, Dr. Burtis criticized Dr. French's use of monthly average prices because averaging necessarily over-compensates some direct purchasers while under-compensating others.

Climate and weather affect the demand for refined petroleum products, yet the Katrina article omits variables that directly measure them, such as temperature and hours of sunlight. Instead, the regression in the Katrina article uses seasonal indicators as instrumental variables for the omitted true causal variables. To the extent the September after Katrina struck was not a typical summer month during the sample period, the estimate of but-for prices in that month will be biased.

The Katrina regression model assumes that the product mix and the production process of oil refineries never change. One assumption in the Katrina article is that the mix of refinery products can be characterized by a 3-2-1 formula of product proportions, and that one can estimate refinery margins by considering only two products, gasoline

and heating oil. Other products are omitted variables, as are variations in product mix. Dr. Burtis's assumptions about product mix and production methods are clearly false. A refinery produces over 2000 products in 17 different categories, with four being of primary importance (gasoline, diesel, jet fuel, and heating oil).[89] Two major categories and 13 other categories of products are omitted from her analysis. In addition, different refineries are designed to produce different product mixes, and every refinery adjusts its product mix in response to changes in demand and supply conditions. "Each refinery has its own unique processing scheme which is determined by the process equipment available, crude oil characteristics, operating costs, and product demand. The optimum flow pattern for any refinery is dictated by economic considerations and no two refineries are identical in their operations."[90] Numerous published studies use mathematical programming models to calculate the optimal mix of refinery products, based on the characteristics of the refinery, the crude oil input, storage and transportation capacities for each product, and final product prices.[91] In brief, Dr. Burtis's Katrina model did not take into account changes in demand (the relative demand for products) and supply (the specific characteristics of the crude oil supplies that were not interrupted and the plants

[89] James H. Gary and Glenn E. Handwerk, *Petroleum Refining: Technology and Economics*, Marcel Dekker, 2001, p. 5.

[90] *Ibid.*, p. 4.

[91] See Alan S. Manne, "A Linear Programming Model of the U. S. Pteroleum Refining Industry," *Econometrica* Vol. 26, No. 1 (January 1958), pp. 67-106; James M. Griffen, :The Econometrics of Joint Production: Another Approach," *Review of Economics and Statistics* Vol. 59, No. 4 (November 1977), pp. 389-97; Darwin Klingman, Nancy Phillips, David Steiger, Ross Wirth, Rema Padman, and R. Krishnan, "An Optimization Based Integrated Short-Term Refined Petroleum Planning System," *Management Science* Vol. 33, No. 7 (July 1987), pp. 813-30; and C. E. Buddington and T. E. Baker, "A History of Mathematical Programming in the Petroleum Industry," *Interfaces* Vol. 20, No. 4 (July-August 1990), pp. 117-27.

that remained in operation) in estimating the but-for refinery profit margin.

In summary, the Katrina regression (1) uses average prices, (2) assumes that all refineries have the same output mix, (3) assumes that the relative quantities of refinery outputs are fixed over time and among refineries, (4) assumes that the composition of demand for refinery products during the aftermath of a devastating hurricane is the same as before the hurricane struck, (5) assumes that the crude oil that refineries obtained after Katrina had the same characteristics as the crude oil from off-shore well in the Gulf that were damaged by Katrina, and (6) uses a crude instrument – seasons – for omitted variables related to weather. According to Dr. Burtis's criticisms of both the *French Report* and the *Noll Report*, these features of the Katrina article render it unreliable as a method for calculating damages.

The Duration and Ending Date of the Before Period

The *Burtis Report* expresses concern about the length of the "before" period (18 months) in relation to the period of alleged exclusionary conduct.[92] As discussed above, the main thrust of this criticism is in connection with the changes in product features during the class period and Dr. Burtis's belief that the effects of these changes on price can not be disentangled from the effects of exclusionary conduct. Notwithstanding that I disagree with Dr. Burtis on the impossibility of implementing a valid price regression, events since the *Noll Report* was submitted may vitiate Dr. Burtis's concern. As discussed in the *Noll Report*, competitors to ITMS began to offer digital downloads that were free of digital rights management (DRM) encryption in September 2007. I stated in

[92] *Burtis Report*, p. 8.

the *Noll Report* that "the creation of DRM-free downloads of audio files is likely to reduce the alleged anticompetitive effects of the prior anticompetitive acts, but … DRM-free audio downloads are not likely to eliminate them."[93] The remaining problems at that time were the limited availability of DRM-free audio recordings from ITMS, the incompatibility between competing portable digital media players and the formats of most audio recordings available through ITMS, the continued use of incompatible DRM encryption for video recordings, and the lock-in of iPod customers with substantial libraries of audio recordings from ITMS.

In January 2009, ITMS began selling all audio recordings without DRM protection.[94] Apple still does not allow competing portable digital media players to download recordings directly from ITMS, but consumers can download recordings on to their personal computers and then upload them to their portable digital media player. Thus, two of the four barriers to competition as of the date of the *Noll Report* have now been eliminated. Apple still does not offer DRM-free video recordings and free removal of DRM protection from recordings that were downloaded before DRM-free recordings became available from ITMS. If the allegations in the *Complaint* are correct, the combined effect of having several competing sources of digital downloads of audio recordings that are DRM free and of ITMS eliminating its DRM protection should increase competition in the market for portable digital media players, although not all the way to the but-for case in which Apple imposes no exclusionary restrictions.

The changed circumstances in the market for digital downloads have two

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[93] *Noll Report*, p. 40.

[94] "Changes Coming to iTunes Store," January 6, 2009, Apple press release.

implications. The first is that in 2009 the market for portable digital media players entered a more competitive era that needs to be taken into account in the before-after test. Second, the capabilities of iPods that were not available as of April 2003 are available in 2009, so that Dr. Burtis's concerns about high correlation between iPod features and the presence of exclusionary conduct are diminished. In particular, if the allegations in the *Complaint* are valid, increased competition eventually should cause iPod prices to fall.

During the summer of 2009, Apple cut the prices of iPods.[95] The information that is publicly available about the price cuts applies only to retail prices. Information about the date, scope and magnitude of wholesale price reductions is not publicly available. In addition, whether these price cuts reflect a reduction in Apple's market power in iPods can not be ascertained without access to information about unit production costs. Thus, no conclusion can be drawn from these price cuts without discovery and analysis.

Dr. Burtis's last claim about the inadequacy of my proposed before-after test is that I did not identify the date at which the before period ends and the anticompetitive harm and damages period begins.[96] According to Dr. Burtis, the alleged anticompetitive harm arises only from the lock-in effect, implying that the damage period cannot begin

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[95] "Chris Brandrick, "Apple Cuts iPod Prices Ahead of Today's Event," *PC World*, September 9, 2009, at http://www.pcworld.com/article/171636/apple_cuts_ipod_prices_ahead_of_todays_event.html; "Apple Adds Video Camera to iPod Nano, Cuts Prices for iPod Touch," *Huffington Post,* September 9, 2009, at http://www.huffingtonpost.com/2009/09/09/apple-cuts-ipod-price-tag_n_280582.html; "Apple Introduces New iPod Tounch Lineup," Apple press release, September 9, 2009; "Apple's iPod Shuffle Now Starts at Just $59," Apple press release, September 9, 2009; "Apple Introduces New iPod Nano with Built-in Video Camera," Apple press release, September 9, 2009; and "Apple Slashes iPod Prices," *Techtree.com*, September 10, 2009, at http://www.techtree.com/India/News/Apple_Slashes_iPod_Prices_Adds_More_Storage/551-106219-893-3.html.

[96] *Noll Report.*, p. 10.

until the first consumer replaces an old iPod. This argument is incorrect because it misstates the allegations in the *Complaint*. The class period began the day that Apple launched ITMS. Damages were immediate because only iPods could be used to play music that was downloaded from ITMS, thereby excluding consumers who purchased other portable digital media players from having access to what was then the only legal source of a large library of recordings from the major record distribution companies.

For the reasons given here, Dr. Burtis has not made valid arguments to support her claim that a reliable before-after test can not be implemented. For this reason, I see no reason to alter the analysis and conclusions in the *Noll Report* regarding this method of calculating damages.

Yardstick

The *Noll Report* expresses reservations about the yardstick method on the grounds that finding a competitive benchmark is likely to be difficult. Dr. Burtis did not correctly identify the reasons for my concern about this method.

The criteria for identifying a benchmark product are that it be technically and functionally similar and that it be sold under similar market conditions.[97] Dr. Burtis interprets these conditions as meaning that the products and market conditions must be essentially identical, which is incorrect. Her conclusion seems to reflect her broader belief, contrary to the published research literature, that reliable price regressions can not be undertaken in product differentiated industries that experience rapid technological progress. She disagrees that PDAs can be comparable products because they do not have

[97] *Noll Report*, p. 55.

the same storage capacity, functionality, user interface, size, battery life, and design.[98] She believes that smart mobile telephones, portable CD players, and other brands of portable digital media players are not appropriate benchmarks because they do not have "similar costs and functionalities and face similar market forces as iPods,"[99] nor do they have the same variety of models.[100]

Dr. Burtis's arguments amount to claiming that these products are not functional substitutes for iPods. Of course, except for other portable digital media players, the proposed benchmark products are not substitutes. The point of the yardstick method is to identify products in other relevant product markets. The requirement is not that they be identical, but that the same fundamental features of the market apply – use of similar inputs (memory, liquid crystal display, microprocessors), similar production technology, and similarity in growth and business cycle features of demand.

The yardstick method requires taking into account the effect of product characteristics on price, and then determining if the yardstick products are less expensive, after adjusting for features and cost, than the iPod, also after adjusting for features, cost and market structure. This method is like the before-after method, except that instead of a "before" period, one uses another product in the same period as the benchmark. As noted in the previous section, successful hedonic price studies have been undertaken for the products that I proposed as benchmarks.

Dr. Burtis lumps in competing portable digital media players with the other

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[98] *Burtis Report*, p. 11.

[99] *Ibid.*

[100] *Ibid.,* pp. 10-11.

yardstick candidates in her claim that supply and demand conditions differ. Here her complaint is invalid, because the task is to estimate a larger hedonic price regression that incorporates all other portable digital media players as well as the iPod. To the extent that iPod prices were higher because its features were superior, the variables measuring these features would account for this effect.

The concern I have about the yardstick method is the cost and availability of information about other products. The issue is whether third-party discovery can obtain the necessary proprietary information about costs, inputs, and product characteristics. Even if this information is forthcoming, this method is more costly to implement. Thus, because I believe that the other methods can be implemented, my conclusion is that this method should not be attempted unless some unexpected problem arises in implementing the other methods.

Mark-Up

The *Noll Report* proposes two versions of the mark-up method. The first, an example of which is the published study of iPod profitability by Dedrick, *et al.* that is cited in the *Noll Report*, is to use information about costs and prices to calculate operating margins for the iPod and other consumer electronics products that are leaders in their markets. These products can be produced either by Apple or by other firms. The second is to calibrate a theoretical model of optimal pricing for the iPod based on prices and costs during the damage period, then calculate the but-for prices that would have been charged had Apple enjoyed less market power in iPods.

Dr. Burtis states that the first method "is effectively the same methodology as his

yardstick method and faces all the problems of the yardstick method" because its validity "hinges on the competitive benchmark being similar to the market at issue in all material ways except for the challenged conduct."[101] Dr. Burtis's only citation for this claim is to sections of my report that deal with the yardstick method. I am aware of no source in law or economics that states that the mark-up method depends on finding a product that is "similar in all material ways except for the challenged conduct." As far as I can tell, Dr. Burtis simply has created her own definition and standards for the mark-up method.

Comparisons of Mark-Ups with Benchmark Products

The difference between the first mark-up method and the yardstick method is as follows. The yardstick method compares the product at issue (e.g., the iPod) and another product (e.g., PDAs, smart phones, or competing portable digital media players) that has similar production technology, inputs, and demand. The analysis then explains prices for both products in a manner that is similar to the before-after test, except that instead of the "before" period the comparison is with the other product during the class period. In effect, the yardstick method requires capturing supply and demand conditions in each market accurately enough to justify attributing differences in prices that are not explained by these conditions to the presence of anticompetitive conduct in one market.

The first mark-up method does not attempt to explain price. Instead this method attempts to determine whether the product at issue (again, the iPod) has a substantially greater mark-up (the margin between price and unit operating costs) than a group of leading products in other markets where firms employ a similar production technology

[101] *Burtis Report*, p. 12-3.

and have similar sales. This method does not necessarily identify a single competitive benchmark. In fact, a comparison with several products makes the test more reliable and less susceptible to the criticism that the study "cherry picks" one or two examples that are favorable to one side of the litigation. In short, the mark-up method is more aggregate than the yardstick method, and does not examine the technical details of products.

Dr. Burtis makes guesses about the products that might be among those compared to an iPod (big-screen televisions, digital cameras, and global positioning satellite navigation systems), and then states that I do not "explain how that profit that Samsung makes on a plasma TV or that Tom Tom, a GPS navigation system seller, makes on a GPS system can provide any basis for estimating the competitive price of iPods."[102] Notwithstanding that these products are Dr. Burtis's examples, not mine, the sentence goes off track because she assumes that the method analyzes price and that the benchmark is the competitive outcome, not the outcome that would have come about in the but-for world. The proper basis for comparison is profit margins, not price, and the proper group of firms for the comparison is market leaders – firms that have superior products and so have some insulation from competition – in consumer electronics products that have similar inputs, production technologies, and sales.

As discussed in the *Noll Report*, Dedrick, *et al.*, estimate Apple's additional market power in iPods compared to other products. They use public sources to determine the components of products, their costs, and their wholesale prices. They find that Apple enjoys unusually high market power in iPods. This additional mark-up, combined with proof that the market power in iPods arises from anticompetitive conduct, provides an

[102] *Burtis Report*, p. 13.

estimate of the damages suffered by purchasers of the two iPod models that were examined in the study. The results of this study cannot be used as a reliable damage calculation because they do not consider many comparisons to the iPod and do not have actual data about costs and wholesale prices. Nevertheless, the method is a good illustration of the mark-up method. The *Burtis Report* does not mention this study, let alone criticize its methods, despite the fact that it is a published version of a comparative mark-up analysis that was cited in my report.

Game-Theoretic Models

As explained in the *Noll Report*,[103] the second version of the mark-up method starts with a theoretical model of price formulation in a concentrated differentiated product market. This model is then calibrated to fit the existing price-cost margin for iPods. The model is then altered to reflect the extent of competition that would have arisen in the but-for world, and a but-for profit margin is calculated. The difference is the overcharge. The validity of the method hinges on establishing that the competitive conditions that are assumed in the but-for analysis are reasonable, which can be based on analogies drawn from similar product markets.

Dr. Burtis claims that I have "not identified any 'consumer electronics market' at all, let alone one that is sufficiently similar to the market in which iPods are sold to accurately 'deduce' what the market concentration should have been."[104] No specific

[103] *Noll Report*, p. 58.

[104] *Burtis Report*, pp. 13-4. Dr. Burtis uses the singular "market" in this sentence, whereas I use the plural. I assume that this is an inadvertent error and that Dr. Burtis knows that I do not regard all consumer products as a single relevant market.

product is offered in this section of the *Noll Report*, although the candidates are the same as are mentioned elsewhere, such as smart phones and PDAs. These products are candidates because they use similar inputs, are small and portable, and have exhibit product differentiation in features, size and design. One basis for picking product markets for comparison is similarities in inputs, cost structures and underlying production technologies. Without knowing whether the extent of scale economies in relation to total sales are similar, one can not know whether two markets are likely to have a similar market structure in the absence of anticompetitive conduct. Information about the cost structure fore iPods requires discovery. Likewise, because this method is based on price indexes, creating price indexes for products in each market requires detailed information about wholesale prices and sales quantities of each model of each product. Information about wholesale prices and sales requires discovery.

Dr. Burtis states that I have not "identified any model that could be used to predict Apple's prices" and that the model I did identify, the Nash-Cournot model, "typically is described as a model in which firms take rivals' decisions as fixed, as well as other assumptions" and "typically assumes that all firms produce a homogeneous product."[105] She also states I "cannot legitimately claim" that the same game-theoretic model "would be appropriate for different iPod models or different time periods when different competitors exist or have different strategies."[106] Dr. Burtis also states: "There is no evidence that Apple sets prices consistent with the underlying assumptions of this game

[105] *Ibid.*, p. 14.

[106] *Ibid.*

theoretic model, or any other model."[107]

I disagree with Dr. Burtis's statements for several reasons. Dr. Burtis is correct to note that the choice of an appropriate game-theoretic model "to predict Apple's prices" depends on Apple's pricing strategy and that I have "no evidence" upon which to choose an appropriate game-theoretic model of Apple's decisions. The cause of the lack of evidence is that it would come from documents and depositions about Apple's pricing policies. To require that I identify the model that will work before any discovery about Apple's pricing strategy is an impossible standard to satisfy.

Dr. Burtis's statement that the Nash-Cournot model "typically" assumes that the product is homogeneous is highly misleading. Cournot's original theory, published in 1838, dealt with homogeneous products, but economics has moved on. Many papers in economics extend the Cournot model to markets in which products are differentiated, firms engage in substantial R&D, and compatibility with other products is valuable.[108]

Although I did mention the Nash-Cournot model in my deposition as an example, I did not commit to it and I did not mention it or any other model in my report. The reason is that I do not yet possess enough facts about Apple's business strategies to know

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[107] *Ibid.*

[108] Nirvikar Singh and Xavier Vives, "Price and Quantity Competition in a Differentiated Duopoly," *Rand Journal of Economics* Vol. 14, No. 4 (Winter 1984), pp. 546-54; Xavier Vives, "On the Efficiency pof Bertrand and Cournot Equilibria with Product Differentiation," *Journal of Economic Theory* Vol. 36, No. 1 (June 1985), pp. 166-75; Shabtai Donnenfeld and Shlomo Weber, "Vertical Product Differentiation with Entry," *International Journal of Industrial Organization* Vol. 10, No. 3 (Septembner 1992), pp. 449-72; Pio Baake and Anette Boom, "Vertical Product Differentiation, Network Externalities, and Compatibility," *International Journal of Industrial Organbization* Vol. 19, Nos. 1-2 (January 2001), pp. 267-84; George Symeonides, "Comparing Cournot and Bertrand Equilibrium in Differentiated Duopoly with Product R&D," *International Journal of Industrial Organization* Vol. 21, No. 1 (January 2003).

how best to model its price policies. Based upon the economics research literature, the leading candidates for a modeling approach are Cournot, Bertrand, and dominant firm/competitive fringe.

As is apparent from the titles of the articles in the preceding footnote, the dominant game-theoretic models of oligopoly in product differentiated industries are Bertrand and Cournot. Both models have been widely applied successfully in empirical studies of many product markets. Both models predict convergence of prices and outputs to the competitive equilibrium as the number of firms increases. For markets with a small number of firms, the models usually predict different prices, but in some cases prices are higher under Cournot while in other cases prices are higher under Bertrand. The differences between the models explain why economists must select a model on the basis of discovery and the success of each model in fitting the data.

Dr. Burtis's descriptions of the behavioral assumption of the Cournot model are technically correct but incomplete and misleading. In Cournot models, the outputs of all firms are an equilibrium if each firm picks output to maximize profits and at the equilibrium output each firm has no incentive to alter its output under the assumption that if that firm changed its output by a small amount, other firms would not respond. In Bertrand models, equilibrium prices maximize the profits of each firm under the assumption that at those prices each firm has no incentive to change its price, assuming that other firms would not respond to a small change in its price. Thus, these models assume that at equilibrium prices (Bertrand) and quantities (Cournot) no firm has an incentive to change its prices or quantities if others do not respond. Because these prices and quantities are less profitable to the group of firms than the monopoly price, the

Bertrand and Cournot prices and quantities are not an equilibrium if firms believe that they can coordinate prices or outputs successfully, as in a well-functioning cartel. Thus, a key assumption of both models is that firms engage in unilateral, independent behavior.

The dominant firm/competitive fringe model assumes that one firm has a substantial technical advantage over its competitors and, as a result, enjoys substantial market power. Other firms also are present, but they capture a sufficiently small share of sales individually that each has no market power. As mentioned above, this model has been used successfully to examine the effects of vertical integration and foreclosure.[109]

Game theoretic models of prices and outputs in product differentiated industries have been extensively used to examine the competitive effect of anticompetitive conduct. Whereas most of this work examines mergers,[110] a substantial body of work has examined vertical integration. The topic is sufficiently important and extensively studied that it is the subject of a 38-page chapter in the *Handbook of Antitrust Economics*.[111]

Dr. Burtis's claim that a game theoretic model is not feasible cannot be based on

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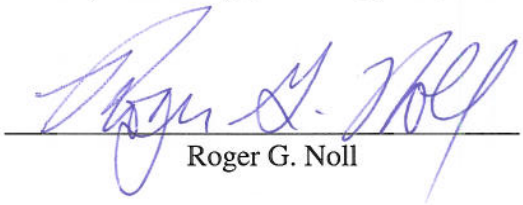
[109] Riordan, *op. cit.* A less general and informal version of this model was used to analyze the effect of the U.S. steel cartel (a collusive group that did not include the entire industry and so acted as a dominant firm). See Donald O. Parsons and Edward J. Ray, "The United States Steel Consolidation: The Creation of Market Control," *Journal of Law and Economics* Vol. 18, No. 1 (April 1975), pp. 181-219.

[110] Janusz A. Ordover, Garth Saloner, and Steven C. Salop, "Equilibrium Vertical Foreclosure," *American Economic Review* Vol. 80, No. 1 (March 1990), pp. 127-42; Yongmin Chen, "On Vertical Mergers and Their Competitive Effects," *Rand Journal of Economics* Vol. 12, No. 4 (Winter 2001), pp. 667-85; Jonathan Baker and Timothry F. Bresnahan, "The Gains from Merger or Collusion in Product Differentiated Industries," *Journal of Industrial Economics* Vol. 33, No. 4 (June 1985), pp. 427-44; Jerry Hausman, Gregory Leonard and J. Douglas Zone, "Competitive Analysis with Differentiated Products," *Annales d'Économie et de Statistique* No. 34 (April-June 1994), pp. 159-80.

[111] Michael H. Riordan, "Competitive Effects of Vertical Integration," in Paolo Buccirossi (editor), *Handbook of Antitrust Economics*, MIT Press, 2008, pp. 145-82.

economics research, where such models are common. Thus, her claim amounts to stating that I have not actually created such a model, shown that its assumptions match the pricing policies of Apple, and shown that it can predict Apple's price data. Whereas this claim is descriptively accurate, it is also irrelevant because I lack the information from Apple that is necessary to develop such a model. At this stage of discovery, the evidence in favor of the workability of this approach, as with the others, is that it is widely and successfully used in economics in broadly similar circumstances.

I declare under penalty of perjury that the foregoing is true to the best of my knowledge and belief. Executed at Stanford, California, October 19, 2009.



Roger G. Noll

CERTIFICATE OF SERVICE

I hereby certify that on October 19, 2009, I electronically filed the foregoing with the Clerk of the Court using the CM/ECF system which will send notification of such filing to the e-mail addresses denoted on the attached Electronic Mail Notice List, and I hereby certify that I have mailed the foregoing document or paper via the United States Postal Service to the non-CM/ECF participants indicated on the attached Manual Notice List.

I certify under penalty of perjury under the laws of the United States of America that the foregoing is true and correct. Executed on October 19, 2009.

s/ Bonny E. Sweeney
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