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10   UNITED STATES DISTRICT COURT

11   NORTHERN DISTRICT OF CALIFORNIA

12   OAKLAND DIVISION

13

14 **THE APPLE IPOD ITUNES ANTITRUST**   **Case No. 4:05-cv-00037 YGR**
    LITIGATION
15   **APPLE'S OPPOSITION TO**
                                                  PLAINTIFFS' DAUBERT MOTION
16   **TO EXCLUDE CERTAIN OPINION**
                                                  TESTIMONY OF KEVIN M.
17   **MURPHY AND ROBERT H. TOPEL**

18   Date: February 18, 2014
                                                  Time: 2:00 PM
19   Courtroom: 5

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Apple has moved for summary judgment, relying in part on reports by two economists, and moved to exclude plaintiffs' economist. Plaintiffs moved at the same time to exclude one aspect of the reports of Apple's economists—the portion dealing with "clustering." In this opposition brief, Apple shows why plaintiffs' motion to exclude should be denied. At bottom, plaintiffs are trying to create the false impression of a battle of experts over statistical significance. But as plaintiffs' new expert all but admits, Apple's experts are correct, and no credible basis exists for the contrary arguments by plaintiffs' experts.

BACKGROUND

As shown by Apple's motion for summary judgment and motion to exclude plaintiffs' expert, plaintiffs offer Professor Roger Noll as the sole purported basis for an incoherent, unsubstantiated theory of antitrust harm and damages. Plaintiffs assert that an Apple software update in 2006, which prevented digital music from one insignificant source of music (RealNetworks music store or RMS) from being played directly on iPods, somehow resulted in RMS customers buying so much more music from Apple that demand for iPods increased so much that Apple was able to, and did, inflate iPod prices.

The real-world facts refute this theory. There is no evidence that *anyone* switched from RMS to Apple's music store as a result of the update or, that if anyone did, the incremental amount of music they bought from Apple led them to buy an iPod rather than a competing player. The named plaintiffs do not fit that description. They have identified no one who does. As Noll admitted, RealNetworks was a minor player, with minimal sales at the time of Apple's software update.

Lacking any real-world evidence that the 2006 update raised iPod prices, plaintiffs rely on two regression models offered by Noll (one for Apple's sales to resellers like   the other for Apple's direct sales to consumers at Apple retail and online stores). *See* Noll Rebuttal Declaration (ECF 740-14) at Exs. 3-A, 3-B. But, as Apple's motion shows, the regressions are replete with fundamental errors and inconsistencies that render them unreliable and unable to support any finding of impact. The regressions lack statistical significance. Mot. Summ. J. and

to Exclude Noll (ECF No. 738) at 20-21. They predict counterfactually that Apple would have

made incremental price changes of a kind Apple has never made. *Id.* at 11-12. They fail to

separate out the purported effect of a previous update that this Court determined was lawful. *Id.*

at 14-16. And they do not account for other factors affecting iPod prices including factors

considered by Apple's Price Committee when setting iPod prices. *Id.* at 18-19.

     To support its showing of these and other fundamental defects in Noll's models, Apple

submitted reports from two highly regarded antitrust economists, Dr. Kevin Murphy and Dr.

Robert Topel, who have extensive experience estimating impact and damages in antitrust cases.[1]

Murphy and Topel showed that Noll vastly exaggerated the statistical precision of his models in

that, as explained more fully below, he calculated "standard errors" as if the "residuals" or "error

terms" were independent when in fact they are highly correlated within groups or "clusters" of

observations. When the "standard errors" are properly calculated using standard econometric

methods known as "clustering"—a technique recommended by the ABA treatise, *Proving*

Antitrust Damages, by plaintiffs' new expert's textbook, and the authorities Noll cites—Noll's

regression results are not statistically significant. This is the expected result given the lack of any

evidence that the 2006 update had any impact on demand for iPods or that Apple considered it in

determining iPod prices.

     In response, plaintiffs have moved to exclude this one aspect of the Murphy and Topel

opinions, contending that their opinion does not "fit" the facts of this case. Plaintiffs' motion to

exclude is based largely on the declaration of a belatedly disclosed expert, Dr. Jeffrey M.

Wooldridge. As shown below, his declaration should be stricken under *Daubert* as unreliable.

Additionally, it should be stricken because plaintiffs did not disclose him by the April 1, 2013

deadline for merits experts or the November 25, 2013 deadline for rebuttal experts. This case has

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[1]   Murphy holds a PhD in economics from the University of Chicago, where he has taught
since 1983. Topel holds a PhD in economics from the University of California, Los Angeles, and
also teaches at the University of Chicago. Both have lectured, written and testified extensively on
the use of econometric methods, including regression models in antitrust cases. Further, both are
experts on the topic of clustering standard errors. *See* Declaration of David C. Kiernan in Support
of Apple's Opposition Brief ("Kiernan Decl.") at Ex. 1 (Murphy Dep., taken January 8, 2014),
256:15-23 & Ex. 2 (Topel Dep., taken January 8, 2014), 239:10-14.

been pending for over eight years. Whether Noll should cluster the standard errors has been at issue in the case for over two years. No justification exists for plaintiffs now trying to salvage Noll's testimony and avoid summary judgment by presenting another expert at the eleventh hour.

In any event, Woolridge's declaration provides no basis to exclude Apple's experts—and instead only confirms that Apple's pending for motion for summary and to exclude Noll's testimony should be granted. Wooldridge's theories are contrary to generally accepted econometric theory and practice including the literature he cites, have not been peer reviewed, are untested, and were manufactured for this litigation. Woolridge's declaration directly contradicts his textbook and research, leading to his deposition admission that if his new opinion on "clustering" were correct, he would need to revise the textbook that he has been using for years. Reflecting his own doubts about his new opinion, after submitting his report Wooldridge started work on theoretical calculations and simulations to test his newly formed opinions. But he has not produced them and says he is not relying on them.

Plaintiffs hope to create the false impression of a battle of the experts by taking advantage of the highly-technical nature of accounting for clustering in calculating regression standard errors and hence statistical significance. Given the complete lack of real-world evidence to support their claim of antitrust impact, and the numerous other defects in Noll's opinions, that effort would fail even if plaintiffs' current motion had any merit. The absence of merit in the motion is further reason to finally bring this long-running case to a close.

STATISTICAL SIGNIFICANCE

This section explains the technical concepts relevant to this motion.

A.   Regression Models and Statistical Significance.

Generally speaking, a regression model is a statistical method used to try to estimate or predict whether some conduct caused an impact on a "dependent" variable like price, student performance, compensation, etc. Expert Report of Topel (ECF No. 740-10), ¶¶ 43-52 ("Topel Report").[2] Because it is a statistical tool, the reliability of the estimates in a regression is

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[2]   A regression measures the average relationship between the "dependent" variable and the
(continued)

measured by statistical significance: "the degree of confidence they have that the estimated value of the coefficient did not arise by chance when the true effect of the variable in question is actually zero." Topel Report ¶¶ 62-63.[3] Here, it is the degree of confidence that the impact of   estimated by Noll's regression did not arise merely by chance when, in fact, the true effect was zero (*i.e.*, no damages). Only where a regression's results are statistically significant are the results deemed reliable.

Statistical significance for a coefficient estimate is calculated using the standard error (standard deviation) of the coefficient estimate, which reflects the precision with which the coefficient is estimated. The smaller the standard error, the more precise the estimate. Topel Report ¶¶ 49, 62; Kiernan Decl., Ex. 3 (ABA Section of Antitrust Law, *Proving Antitrust Damages: Legal and Economic Issues*, (2010)) at 144-147. Specifically, statistical significance is measured by taking the ratio of a coefficient estimate to its standard error (called the "t-ratio" or "t-statistic"), which measures the distance in standard deviations (errors) between the estimated value of the coefficient and zero. Topel Report ¶¶ 62-63. The larger the t-statistic, the further away the estimate is from zero, which increases the confidence that effect of the variable being measured is not zero.[4]

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conduct at issue represented by an "indicator" or "dummy" variable, while controlling for other "explanatory" or "independent" variables that could also affect the dependent variable. *Id.* Noll claims that his dummy variable ("iTunes_7.0_rev") measures the impact on the dependent variable (iPod prices) of the challenged update   controlling for other explanatory variables.

[3]   Statistical significance is often represented at various thresholds (e.g., 1%, 5%, or (most leniently) at 10% levels). The smaller the significance level used, the greater the confidence in the results. For example, at the 1% level, there is no more than 1% probability of getting the result merely by chance. Topel Report ¶¶ 62-63.

[4]   A common benchmark for statistical significance is a t-statistic that is 2.0 or larger ($t \geq 2.0$), which means the estimated coefficient is at least twice its standard error (two standard deviations). Id. A t-statistic of 2.0 corresponds to approximately a 5% level of statistical significance—i.e., there is a 5% probability that a coefficient estimate as large as the one obtained could have arisen by chance if the true value of that coefficient is zero. Id. A t-statistic of t = 2.58 corresponds to approximately a 1% level of statistical significance—i.e., a 1% probability of arising by chance; and a t-statistic of t = 4.9 corresponds to a .0001% probability of arising by chance—i.e., a one-in-one million chance. Topel Report ¶ 62-63.

B.   **Independence Assumption In Calculating Standard Errors.**

The calculation of the standard error is based on the "residuals" or "error terms" calculated when estimating the price for each observation in the regression. Kiernan Decl., Ex. 3 at p. 144-145. The residual represents all the unmeasured factors or unobserved factors that affect the price of the observation that are left out of the regression either because a variable was not included for that factor or because the factor is "unobserved" (*i.e.*, not recorded in the data—*e.g.*, unobserved economic factors or market conditions). Topel Report ¶ 46; Kiernan Decl., Ex. 3 at pp. 144-145. As a general rule, the larger the number of independent observations and thus residuals used to estimate the standard errors the smaller will be the estimated standard errors.

A fundamental assumption in calculating the standard errors and thus the statistical significance of the coefficient estimates is that the residuals are statistically independent (uncorrelated)—knowledge of the residual for one transaction provides no information about the residual for another transaction. Noll Rebuttal pp. 38, 40; *see also* Expert Report of Murphy (ECF No. 740-8), ¶ 98 ("Murphy Report"); Topel Report ¶ 75; Kiernan Decl., Ex. 3 at 144-45 & Ex. 4 (Angrist, *Mostly Harmless Econometrics: An Empiricist's Companion* (2009)) at pp. 293-294 & Ex. 7 (Cameron, *A Practitioner's Guide to Cluster-Robust Inference* (2013)) at p. 7 ("Intuitively, if errors are positively correlated within cluster then an additional observation in the cluster no longer provides a completely independent piece of new information.").[5][6] Residuals are considered independent when they are not correlated to each other. *Id.*

Residuals can be correlated for various reasons. The typical reason is that, within the population of observations (here, iPod transactions), certain groups of observations are affected by common factors that are <u>not</u> captured by the variables in the model because they were left out

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[5]   As Noll puts it, "The standard assumption about the error term [residual] is that it is independent and identically distributed with a mean of zero and finite variance, which means that the value of [the residual] does not depend on any of the other variables in the equation and that the variance of the error term [the residual] is the same for each observation." Noll Rebuttal p. 40; *see also* Kiernan Decl., Ex. 3 at p. 144.

[6]   Noll relies on both the Angrist book and Cameron article in his rebuttal report as do Murphy and Topel. *See* Noll Rebuttal fns. 14, 18, 21 (Angrist) and 11, 14-15 (Cameron)

or because they are unobserved. Murphy Report ¶ 79; Topel Report ¶¶ 48, 85; Noll Rebuttal at p. 41; Expert Declaration of Jeffrey M. Wooldridge, filed as Ex. 1 to Pls.' *Daubert* Motion, (ECF 737) at p. 3 ("Wooldridge Report").[7] Wooldridge and Noll illustrate when correlation arises with an example taken from Wooldridge's graduate textbook, *Econometric Analysis of Cross Section and Panel Data* (2010).[8] The example involves estimating the effect of class size on test scores of students within a state.[9] As Wooldridge explains, because "student outcomes within a school are likely to be influenced by common factors determined at the school level, such as (unmeasured) teacher or principal quality," there will be "cluster correlation" at the school level. Wooldridge Report at p. 3. Failure to cluster at the school level will "over-estimate the magnitude and statistical significance of the effect of class size;" without accounting for the correlation, the "regression under-estimated the standard error of the regression coefficient as well as over-estimated the value of the coefficient." Noll Rebuttal at p. 42.

If the residuals in the regression are correlated within a group of observations (*i.e.*, not independent), that correlation must be accounted for in calculating standard errors. Topel Report ¶ 74-76; Supplemental Report of Murphy & Topel (ECF No. 740-23) at ¶ 5 ("Murphy/Topel Supp."); Kiernan Decl., Ex. 3 at 145-146. If no correction is made, the standard errors will be miscalculated and generally lead to overstating the level of statistical significance; *i.e.*, the standard errors will be too small. Topel Report ¶¶ 74-76; Murphy/Topel Supp. ¶ 5; Kiernan Decl.., Ex. 7 at p. 4 & Ex. 3 at pp. 145-46. As Cameron (relied on by Noll) explains, "Failure to control for within-cluster error correlation can lead to very misleadingly small standard errors, and consequent misleadingly narrow confidence intervals, large t-statistics and low p-values. It is

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[7]   *See also* Kiernan Decl., Ex. 3 at 145-146 (collecting examples).

[8]   Noll relies on an outdated (2002) version of Wooldridge's textbook. As Wooldridge points out in the Preface to the 2010 edition, the first edition relied on by Noll "was hardly perfect" due in part to "gaps in coverage" and "some important developments in econometrics." Kiernan Decl., Ex. 5 at p. xvii. He revised the chapter Noll relies on "the most," including adding new material on clustering reflecting current research ignored by Noll.

[9]   Noll Rebuttal at p. 42; Wooldridge Report at p. 3; Kiernan Decl., Ex. 5 (Wooldridge, *Econometric Analysis of Cross Section and Panel Data* (2010)) at p. 864.

1 not unusual to have applications where standard errors that control for within-cluster correlation

2 are several times larger than default standard errors that ignore such correlation." Kiernan Decl.,

3 p. 4.

4 **C.   How to Test for and Correct Correlation of Residuals.**

5 Standard procedures exist to test whether the errors within groups are correlated. *Id*., Ex.

6 6 (Noll Dep. Tr., taken Dec. 18, 2013) at 24:9-14; *see also* Ex. 3 at 147, n. 73. One test is to see

7 "whether the mean residual errors … are statistically significantly different from zero, which

8 would have to be the case if the errors within a cluster are correlated." Noll Rebuttal at p. 34. If

9 there is reason to suspect that the residuals are correlated, one should test the assumption.

10 Kiernan Decl., Ex. 7 at p. 20; *see also* Ex. 3 at 147 & n. 73. As discussed below and in Apple's

11 motion to exclude, although there is reason to suspect that the residuals are correlated, Noll

12 refused to perform any tests.

13 Standard methods also exist to correct for correlation of residuals. *Id.*, Ex. 6 at 24:9-14;

14 *see also* Ex. 3 at p. 146; Murphy Report ¶ 98; Topel Report ¶ 81; Wooldridge Report at p. 3. The

15 method used by Murphy and Topel is called "clustering" standard errors. It has "become widely

16 used" in antitrust cases and is "easily implemented" using standard statistical software.[10] Kiernan

17 Decl., Ex. 3 at p. 146 & Ex. 7 at pp. 4-5; *see also* Murphy/Topel Supp. at ¶ 9; Murphy Report ¶

18 98; Topel Report ¶ 81; Kiernan Decl., Ex. 1 at 266:7-267:1; Kiernan Decl., Ex. 8 (Solon, Haider,

19 Wooldridge, *What are we Weighting For?* (2013)) at pp. 9-10. Wooldridge recognizes this. In

20 his school test scores example, he identifies "a couple of appropriate responses" to correct for

21 correlation at the school level, including "comput[ing] standard errors that allow for correlation in

22 the errors within a school"—*i.e.*, clustering. Wooldridge Report at p. 3; *see also* Kiernan Decl.,

23 Ex. 5 at p. 864. A recognized benefit of clustering is that, in general, it performs well even when

24 there is no correlation among residuals. Topel Report at n.76; Kiernan Decl., Ex. 1 at 277:6-19;

25 Ex. 3 at 147.

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27 [10]   For example, "Stata, a popular econometrics software package, includes a 'cluster' option
for calculating standard errors assuming unspecified within-group (cluster) correlation between
the error terms." Kiernan Decl., Ex. 3 at p. 146, n. 71.

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D. **Application of These Principles Here**

Noll claims that nearly all his coefficients are statistically significant at the 1% level, including his variable for the   They are actually much more significant than that—so significant in fact that they are not believable. Exhibits 3-A and 3-B of Noll's rebuttal report (ECF No. 740-14), sets forth the coefficient estimate for each variable and its purported standard error and level of statistical significance.

Noll's standard errors are unbelievably small because he estimates them based on 2.1 million observations in the reseller regression and 36.9 million observations in the direct sales regression, assuming that he has 2.1 million and 36.9 million independent residuals. Noll Rebuttal Exs. 3A, 3B.

ARGUMENT

I. **APPLYING THESE GENERALLY ACCEPTED PRINCIPLES, MURPHY AND TOPEL SHOW THAT THE RESIDUALS ARE HIGHLY CORRELATED AND THAT NOLL'S RESULTS ARE STATISTICALLY INSIGNIFICANT WHEN THE CORRELATION IS CORRECTED.**

As Cameron explains, if there is reason to suspect that the residuals are correlated, one should test the assumption. Kiernan Decl., Ex. 7 at p. 20; *see also id.*, Ex. 3 at p. 147.

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[11]

[12]

[13] iPods are in hierarchical categories defined by Apple—model, generation, family (like taxonomic categories in biology, from Kingdom to Species). The iPod model (classic, nano, mini, shuffle, touch) describes the highest level of commonality (e.g., shuffles are small without screens). Generation (e.g., 1st, 2nd, 3rd, 4th, etc.) refers to the next more narrow level of commonality, and include iPod models that have features common for that generation (e.g., iPod nano 2nd generation had iTunes 7.0, but iPod nano 1st generation did not.) Family is the most specific, referring to an iPod of a certain model and generation with a specific feature set (e.g., iPod nano 2nd generation 4GB vs iPod nano 2nd generation 6GB).

[14]

[15] *See, e.g.,* Murphy Report ¶ 110-112, Murphy Dep. Tr. at 135:7-136:4 (attached as Exhibit 10 to Sweeney Decl. in Supp. of Pls.' Mot. (ECF No. 737)); *see also* Kiernan Decl., Ex. 10 (various Apple Price Committee Documents).

And if such correlation is not corrected, the regression "will lead to very misleadingly small standard errors, and consequent misleadingly narrow confidence intervals, large t-statistics and low p-values"[17] and "over-estimate[] the magnitude and statistical significance of the effect of [   ]."[18]

Noll admitted that his model should include any product attribute so long as "prices plausibly could be affected by it." Noll 2d Supp. Decl. (ECF No. 685) at p. 9. Nevertheless, he has excluded such features. Topel Report ¶ 112, n. 94, *see also* Kiernan Decl., Ex. 10. Most of the omitted attributes were considered by Apple's Price Committee when setting prices for iPods. *Id.* By omitting variables that impact prices of iPods, Noll has introduced correlation in the residuals that allows him to vastly underestimate the standard errors.

Because there is ample reason to suspect correlation, Murphy and Topel used standard tests to determine whether the residuals are highly correlated at the family and quarter level. They are. Topel Report at ¶ 80 & Ex. 14a thereto; Murphy Report ¶ 97 & Ex. 13a thereto; Murphy/Topel Supp. at n. 14 and Exhibits JT-3a and JT-3b thereto.[19] And after correcting for the

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[16]   Or in Noll's terms, the "outcome for a member of a group [here prices for iPods within a family] may be affected by factors other than the treatment variable [here factors other than iTunes 7.0] that are common to all group members [here all iPods within a family]." Noll Rebuttal at p. 41.

[17]   Kiernan Decl., Ex. 7 at p. 4.

[18]   Noll Rebuttal at p. 42; *see also* Wooldridge Report at p. 3; Kiernan Decl., Ex. 5 at p. 864.

[19]   Murphy and Topel calculated the estimated residual (error term) for each of the transactions. Within each family and quarter, they divided the residuals into two equal size groups and calculated the average residual within the group. If the residuals are independent, the mean should be zero--the residuals should be grouped around zero. The results, however, show the opposite. The mean residuals are not grouped around zero, they range from -.485 to .347 for the reseller regression and from -.692 to .273 for the direct regression. And they are strongly
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high correlation using clustering, Murphy and Topel demonstrate that Noll's results are statistically meaningless; *i.e.*, the results are indistinguishable from zero. Murphy/Topel Supp. ¶ 9.[20]

Despite having reasons to suspect correlation at the family level including the results of the tests run by Murphy and Topel, Noll refused to employ any of the standard, accepted procedures (including the one he referred to in his Rebuttal Report) to test the independence assumption.[21] Refusing to apply generally accepted methods and ignoring facts that undermine his opinion are grounds alone to exclude his opinions.

II. PLAINTIFFS' EFFORT TO REHABILITATE NOLL BY ATTACKING APPLE'S EXPERTS IS WITHOUT MERIT AND PROVIDE GROUNDS TO EXCLUDE NOLL AND WOOLDRIDGE.

Plaintiffs attack Murphy's and Topel's testimony on statistical significance and clustering on the grounds that (a) clustering is never appropriate when the regression uses the entire

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positively correlated. The 45 degree line in the graph shows the place on the graph at which the residuals are perfectly correlated. Here, the residuals lie so close to the 45-degree line showing that the residuals are highly correlated within family and quarter. *See* Topel Report ¶ 80; Murphy Report ¶ 97.

[20]   For the first time in this case, in a footnote, Plaintiffs assert that regression results need not be statistically significant to be admissible. Mot. at 8 n.12. That issue has no bearing on the current motion to exclude Murphy and Topel's criticism of Noll's methodology in calculating statistical significance. But plaintiffs' assertion is not true. Their sole authority for the assertion is addressed to epidemiological studies, not to regression models proffered as the sole basis for a claim of antitrust impact and measure of damages. Cook v. Rockwell Inter. Corp., 580 F. Supp. 2d 1071, 1102-03 & n.29 (D. Col. 2006). Noll offers no opinion that his regression models could be relied upon to find impact or damages if their results are not significantly different from zero—and no such assertion would make sense. Recognizing as much, Noll asserts that the results should be accepted because the coefficients are "highly significant." Noll Report, p. 90. In his Rebuttal Report, he never made plaintiffs' argument. Instead, he vigorously defends his reported levels of statistical significance. Nor did Murphy say that statistical significance is irrelevant. He said only that there is no bright-line for statistical significance and a T-statistic of 1.95 is not materially different from one of 2.05. See Ex. 10 to Pls.' Mot. at 51:9 to 52:9.

[21]   This is not the first time the clustering issue has been raised. During the class certification phase, Apple's experts demonstrated that Noll's regressions, which are based on the same data, overstated the standard errors by calculating them assuming the residuals were independent when in fact they were not. *See, e.g.*, Second Supp. Expert Report of Dr. Michelle Burtis, (ECF No. 692) at ¶ 42-46.

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1   population of all transactions as opposed to a sample of the data, (b) Murphy and Topel engaged

2   in "ex post clustering"; and (c) even if clustering is appropriate when using entire population, the

3   technique used by Murphy and Topel is inappropriate because there are too many observations

4   per cluster.

5   For each of these points, plaintiffs rely on Woolridge, who spent 12 hours on his report

6   and largely parrots the arguments Noll made in his rebuttal report. Wooldridge Report at p. 2;

7   Kiernan Decl., Ex. 11 (Wooldridge Dep. Tr., taken Jan. 6, 2014) at 8:16-20, 10:15, 53:8. But

8   when confronted at deposition with generally accepted econometrics and his own writings,

9   Wooldridge was forced to admit that his (and by extension Noll's) theories have no support, have

10 not been peer reviewed, and are contrary to generally accepted econometrics and literature

11 including Wooldridge's own writings on the subject. *Wagner v. County of Maricopa*, 673 F.3d

12 977, 982 (9th Cir. 2012) (an expert's analysis should be "supported by the typical *Daubert* factors

13 – testing, peer review and general acceptance"). Such theories and opinions obviously

14 "conceived, executed, and invented solely in the context of th[e] litigation" are per se

15 inadmissible. *Johnson v. Manitowoc Boom Trucks, Inc.*, 484 F.3d 426, 434-35 (6th Cir. 2007).

16   **A.   The Claim That Clustering Is Only A Problem When Sampling Is Objectively**

17   **Wrong And Should Be Excluded Under *Daubert***

18   Plaintiffs' principal argument is that it is appropriate to account for within-group

19 correlation (clustering) only when the data were drawn as a so-called "cluster sample," not when

20 using the entire population of transactions. Pls.' Mot. 9-10; Noll Rebuttal at p. 10; 39-43. They

21 assert that, because Noll used virtually all iPod transactions and not a sample of transactions,

22 there can be no clustering problem. They have no support for this theory.

23   As Murphy and Topel explain, accounting for clustering is the norm in applied

24 econometrics whether dealing with a population or sampling. "The issue is not whether you have

25 'all' of the data or merely a sample, but whether the residuals in the statistical model assumed by

26 Professor Noll are correlated." Murphy/Topel Supp. at ¶ 11(b) (citing sources); *see also* Kiernan

27 Decl., Ex. 3 at 144-147. Indeed, in antitrust cases, the parties usually have the entire population

28 of transactions from defendants—not random samples. Kiernan Decl., Ex. 1 at 266:21-267:1. In

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these situations, the ABA Section of Antitrust Law, *Proving Antitrust Damages: Legal and Economic Issues* (2010), warns that within-group correlation of regression residuals must be considered and corrected. *Id.* at 144-147. Otherwise "the incorrectly estimated standard errors generally will be biased downward, making the regression coefficients seem to be more precisely estimated than they really are. As a result, a statistical test on the coefficients may yield what appears to be a statistically significant result but is not." Kiernan Decl., Ex. 3 at pp. 145-146. And none of the authorities cited by Noll or Wooldridge support their argument that correlation of residuals within group is limited to cluster samples.

Given this authority, it is no surprise that Noll retreated at his deposition and admitted that the independence assumption applies when using the entire population of transactions and that residuals could be correlated within groups. Kiernan Decl., Ex. 6 at pp. 44-45. But as discussed above, he refused to employ any procedures to determine whether the residuals are correlated.

And now Woolridge has effectively done the same thing. In his declaration, Wooldridge restates Noll's opinion that the clustering problem only arises when sampling, and never arises when the regression utilizes the entire population of data. He asserts that any clustering that occurs after collecting the data (what he terms "ex post clustering") is inappropriate. Wooldridge Report at p. 9. But when confronted at deposition with his own writings, he admitted that he could point to no authorities that support his opinions, and that they are untested and have not been peer reviewed, and were formed after being retained in this litigation. Kiernan Decl, Ex. 11 at 91:22-92:7; 62:21-24.[22] In fact, it appears that Wooldridge coined the term "ex post clustering" specifically for this litigation. He can point to no other source in the field of econometrics that uses the term. *Id.* at 90:21-24.

Although he allegedly first began "thinking" about the theory several years ago (*id.* at 62:18-21; 64:8-19), it was only *after* being retained in this litigation in December 2013 for $500/hour and *after* submitting his declaration that he "worked out a little bit of theory as well as

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[22]   The closest academic work he could point to was his article on stratified sampling. But he admitted that it did not address whether "ex post clustering is inappropriate when dealing with an entire population." Kiernan Decl., Ex. 11 at 92:11-14.

the simulation" to test his and Noll's opinions. *Id.* at 62:21-24. However, he was explicit that he is not relying on any of this preliminary work for support. *Id.* at 13:8-11, 18:5-12.

His new theory contradicts the economics literature on when clustering problems arise and contradicts how econometricians have dealt with the issue "for a long time." *Id.* at 90:24-91:6. It also contradicts Wooldridge's own work. Before being retained, Wooldridge recognized that clustering can be a problem even when using the entire population of data. In his recent graduate textbook on econometrics, for example, he explains that the "cluster sampling" problem refers to the problem where groups are drawn from a population rather than individual units, which in turn cause "the units within the cluster [to be] correlated through unobserved 'cluster effects.'" Kiernan Decl., Ex. 5 at p. 853. Later in the chapter he is clear that the problem is not limited to sampling: "it is probably a sensible rule to at least consider the data as being generated as a cluster sample whenever [variables] at a level more aggregated than the individual units are included in an analysis. For example, in analyzing firm-level data, if industry-level [variables] are included then we should treat the data as a cluster sample, with each industry acting as a cluster." *Id.* at p. 864. Indeed, in his Example 20.3 to show "Cluster Correlation in Teacher Compensation," he uses "virtually" the entire population of data of average compensation at the school level for teachers in Michigan and states that he "view[s] this as a cluster sample of school districts, with the schools within districts representing the individual units" *Id.* at p. 868; Ex. 11 at 127:15-128:23.

Directly contradicting his current assertions, his textbook also recommends clustering *after* collecting the data (*i.e.*, what he now derides as "ex post clustering") if the researcher has reason to believe that there are common unmeasured factors that affect outcomes. Using the school example, Wooldridge' textbook and declaration note that, if the researcher originally sampled fourth-grade classrooms, the researcher would cluster at the classroom level—that is the "cluster sample." Wooldridge's declaration (pp. 3-4) states that it would be improper later to cluster at the school level because such "ex post clustering" is done after the data is collected. He accuses Murphy and Topel of effectively doing this. However, his textbook acknowledges that, if the researcher is "worried about correlation in student performance not just within class but also

within school, then [the researcher] can define the clusters to be the schools." *Id.*, Ex. 5 at p. 864. That is the equivalent of what Murphy and Topel did in this case. Because they considered that iPod prices could be correlated within family, they defined the clusters to be family.

When asked about the discrepancy between his declaration and textbook, Wooldridge said he "might rethink" what he previously wrote in his textbooks and "re-examine [certain] statement[s] in light of [the] recent research that [he] has done." *Id.*, Ex. 11 at 117:6-15. Ultimately, he conceded that he would need to rewrite his text and claimed that the ABA's treatise, *Proving Antitrust Damages*, should be rewritten in light of his new, unsupported theory. *Id*. 159:9-11.

In short, Wooldridge's opinions have been custom-manufactured for this litigation, are supported only by his own *ipse dixit* and run contrary to his own previous works on the subject and the articles he cites in his declaration. Neither *Daubert* nor Rule 702 requires a district court to admit such opinion evidence. *See Daubert v. Merrell Dow Pharm., Inc.*, 43 F.3d 1311, 1318 (9th Cir. 1995) (*Daubert II*) (requiring expert to "point to some objective source" to show conclusions are scientifically valid). Accordingly, the Court should exclude Wooldridge's declaration.[23] And it provides no support for plaintiffs motion to exclude.

B.   Plaintiffs' Claim That Clustering Overestimates The Standard Errors Is Baseless

Relying on Noll and Wooldridge, plaintiffs contend that, even if clustering is appropriate, it leads to biased results when the ratio of the number of clusters (N) and the number of observations per cluster (T) is large. Motion at 12. They argue that, as the number of observations per cluster increases relative to the number of clusters, clustering will overstate standard errors and understate statistical significance of regression results. *Id.* (citing Wooldridge

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[23] *See also Cabrera v. Cordis Corp.*, 134 F.3d 1418, 1423 (9th Cir. 1998) (explaining expert opinion unreliable where developed "expressly for the purpose of testifying" and the expert cannot "identify any peer-reviewed research justifying his conclusions"); *Lust v. Merrell Dow Pharmaceuticals, Inc.*, 89 F.3d 594, 597 (9th Cir. 1996) ("When a scientist claims to rely on a method practiced by most scientists, yet presents conclusions that are shared by no other scientist, the district court should be wary that the method has not been faithfully applied.").

1   Report at p. 9). This new theory, like the others, was manufactured for this litigation, has no

2   support in peer reviewed or any other literature, is untested, and contradicts the very authorities

3   Noll and Wooldridge cite. Indeed, at deposition, Wooldridge admitted he had no authority for it.

4   Kiernan Decl., Ex. 11 at 131:4-132:7. And none of the authorities they cite support them.

5   Noll cites the book by Angrist and Pischke, but that work shows the opposite of Noll's

6   opinion. Angrist and Pischke establish that the conventional estimators used to estimate standard

7   errors become "increasingly misleading" when the number of observations per group and the

8   amount of within-group correlation increase. Kiernan Decl., Ex. 4 at p. 310; *see also* pp. 319-

9   320.[24] This is precisely when clustering should be performed, because it leads to more accurate

10 results. *Id.*; *see also* Topel Report at ¶ 75; Kiernan Decl., Ex. 12 (Hansen, *Asymptotic Properties*

11 *of A Robust Variance Matrix Estimator For Panel Data When T is Large* (2007)) at pp. 612-615.

12 And as Noll admits, Angrist and Pischke state that clustering performs well when the number of

13 clusters is larger than about 50.[25] In this case, there are over 375 clusters when clustering by

14 family and quarter, and over 68 clusters when clustering by family.[26]

15   Wooldridge confirmed that Noll has no support for this novel theory. At deposition, he

16 admitted that no authority supports the opinion that the clustering estimator used by Murphy and

17 Topel produces unreliable results or that it performs more poorly as the number of observations

18

19 [24] "Conventional [OLS] standard errors become increasingly misleading as *n* [the number of
    observations per group] and *p* [the amount of within-group correlation] increase." Kiernan Decl.,
20 Ex. 4 at p. 310; *see also* pp. 319-20.

21 [25] Noll Rebuttal at n. 18 ("Angrist and Pischke [ ] whimsically state that 42 is the magic number
    of clusters . . . [o]f course, no magic solution exists, but the effects of violating the standard
22 assumptions about the distribution of errors declines as the number of clusters increases."); *see*
    also Kiernan Decl., Ex. 4 at § 8.2.3; *see also* p. 313: "The [CCM estimator] is consistent as the
23 number of groups gets large under any within-group correlation structure and not just the
    parametric model in (8.2.30)."

24 [26] Noll makes the added argument that there is no clustering problem where there are large
25 number of clusters. Wooldridge does not support this part of Noll's opinion, presumably
    recognizing that it is wrong. Nor do Plaintiffs rely on it in their motion. Noll has it exactly
26 backwards. The text Noll cites states that a large "number of clusters" is precisely the condition
    that makes clustering a reliable and accurate method for calculating standard errors than the
27 estimator used by Noll. *See* Kiernan Decl., Ex. 4 at § 8.2.3, p. 313 & Ex. 12 at 612-615 & Ex. 11
    at 135:17-139:13.
28

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per cluster increase relative to the number of clusters. Kiernan Decl., Ex. 11 at 145:19-147:9.

Wooldridge claimed that he started working on "simulations" to test his new theory after

submitting his report, *id.* at 145:16-146:23, but is not relying on those simulations. *Id.* at 13:8-11.

The one paper Wooldridge does cite, Christian Hansen's *Asymptotic Properties of A*

Robust Variance Matrix Estimator For Panel Data When T is Large, shows exactly the opposite

of what Noll and Wooldridge claim. According to Hansen, it is the number of clusters (N) that

matter, not the ratio between the number of observations per cluster (T) and the number of

clusters (N): "[I]t is the N dimension and not the size of N relative to T that matters for

determining the properties of the CCM estimator." Kiernan Decl., Ex. 12 at p. 598; *see also* p.

611. Dr. Hansen also includes a number of simulations, which Wooldridge admitted show that,

as the number of clusters increase, the standard estimator performs more poorly while clustering

leads to much more accurate standard errors. Kiernan Decl., Ex. 11 at 135:23-139:13. This is

exactly the opposite of what Noll and Wooldridge claim.[27] Hansen's results are consistent with

Angrist and Pichke's opinion that clustering performs well when, as here, the number of clusters

is larger than about 50. *Id.* at Ex. 12, p. 612-615 (showing that clustering performs better as

number of clusters increases from 10 to 50; it also shows that clustering performs better as the

number of observations per cluster increases).

Finally, Plaintiffs and their experts assert that clustering "in the absence of any need for

one is not harmless" because it bias the results. Wooldridge's declaration (p.5) cites no authority

for that proposition, and at deposition he admitted he was unaware of any. And as demonstrated

above and recognized in the ABA treatise Proving Antitrust Damages, clustering produces

accurate estimates of standard errors even when there is no within-group correlation among the

residuals. Kiernan Decl., Ex. 3 at p. 147.

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[27] At deposition, Wooldridge admitted that he had not carefully reviewed Hansen's work. Early
in the deposition, he claimed that Hansen supported his opinion that ratio matters and that
clustering performs more poorly as the number of observations increase. Kiernan Decl., Ex. 11 at
131:4-132:2, 135:9-16. As discussed above, when confronted with the paper, Wooldridge was
forced to admit that Hansen's paper states the opposite.

1 **C.   Clustering With Or Without Time Period Demonstrates That Noll's Results**

2 **Are Not Statistically Significant**

3   Plaintiffs also criticize Murphy and Topel for clustering at the family and quarter level,

4 contending that there is no justification to cluster by time period. That assertion is wrong on two

5 counts. First, even if the standard errors are clustered only by family and not by time period,

6 Noll's results still are not statistically significant. Murphy/Topel Supp. ¶¶ 8-10, n. 14 & Exhibits

7 JT3a and JT3b thereto. Second, whether or not a time dimension should be used, there clearly is

8 correlation of residuals which has not been properly corrected in calculating standards errors.

9 When corrected, with or without time period, Noll's results are not statistically significant.[28]

10   ****

11   In short, Plaintiffs' motion should be denied. Murphy and Topel have applied generally

12 accepted econometric methods used in antitrust cases and showed that Noll inflated the statistical

13 significance of his regressions by calculating standard errors on the assumption that the errors are

14 independent when in fact they are not.

15 **III.   WOOLDRIDGE'S REPORT SHOULD BE STRICKEN.**

16   For the reasons shown above, Wooldridge's opinions on clustering are unreliable and do

17 not pass muster under *Daubert*. His theories are that (i) clustering is never appropriate when

18 using the entire population, (ii) what he calls "ex post clustering" is inappropriate, and (iii)

19 clustering is inappropriate where ratio between number of clusters and number of observations is

20 large. These theories have no support. They are contrary to generally accepted econometrics and

21 _____

22 [28]   Although not relied on by plaintiffs, Noll makes the added argument that no clustering is
   necessary because his regressions include all statistically significant variables, which control for
   any possible correlation within family. The theory is that, if all the important variables that affect

23 price of the various types of iPods are included in the regression, clustering may not be necessary
   because the variables in the model capture the common factors. Noll is wrong on at least two

24 counts. First, whatever variables Noll included, the critical assumption that needs to be tested is

25 whether the residuals remain correlated or not. If they are, they must be corrected. As Murphy
   and Topel demonstrated, the tests show that the residuals remain highly correlated within family

26 as would be expected. Second, Noll omitted statistically significant variables. Murphy/Topel
   Supp. ¶¶ 8-11, 17-18. This not only renders his coefficient estimates unreliable by creating

27 omitted variable bias as discussed in Apple's motion to exclude, but also can create correlation to
   the extent that the omitted variables had common affect within family of iPods.

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1 his own writings. They have not been peer reviewed. And they were manufactured for this

2 litigation. *Wagner,* 673 F.3d at 982 (an expert's analysis should be "supported by the typical

3 Daubert factors – testing, peer review and general acceptance"). Such theories and opinions

4 obviously "conceived, executed, and invented solely in the context of th[e] litigation" are per se

5 inadmissible. *Johnson,* 484 F.3d at 434-35.

6   In addition, the declaration should be stricken because plaintiffs did not timely disclose

7 Wooldridge as an expert. The schedule in this case, after several modifications, ultimately set

8 April 1, 2013 as the date for plaintiffs to disclose experts and November 25 as the date for

9 Plaintiffs to serve rebuttal reports responding to Apple's experts, 25 days before *Daubert* motions

10 were due. ECF No. 735. No exception was made for a rebuttal report to be submitted with

11 *Daubert* motions. *Id.* Whether Noll should cluster the standard errors has been at issue in this

12 case for over two years. *See, e.g.*, Second Supp. Expert Report of Dr. Michelle Burtis (ECF No.

13 692) at ¶ 42-46. Nevertheless, plaintiffs waited until after discovery was completed and disclosed

14 Wooldridge's identity on the day *Daubert* motions were due. This left defendants with only two

15 weeks to respond to the new expert, who should have been disclosed months ago. This Court

16 should strike the late-filed declaration on this ground alone. *Reed v. Smith & Nephew, Inc.*, 527

17 F. Supp. 2d 1336, 1348 (W.D. Okla. 2007) (striking declaration of undisclosed expert submitted

18 in support of *Daubert* motion); *Moore v. Napolitano*, 926 F. Supp. 2d 8, 25 n.12 (D.D.C. 2013)

19 (same); *Jeffries v. Centre Life Ins. Co.*, No. 1:02-cv-351, 2004 WL 5506494 at *1 (S.D. Ohio Jan.

20 28, 2004).

21 **IV.   PLAINTIFFS' ASSERTION THAT MURPHY'S OPINIONS HAVE BEEN**

22   **REJECTED ELSEWHERE IS UNFOUNDED.**

23   Plaintiffs' assertion that Murphy's testimony in two cases has "failed to withstand"

24 scrutiny is irrelevant and incorrect. Irrelevant, because it has no bearing on the invalidity of

25 Noll's regression in this case—or of Murphy's and Topel's testimony showing that invalidity.

26 Incorrect, because it misstates the rulings in those two cases.

27   In *In re High-Tech Employee Antitrust Litig.*, 289 F.R.D. 555 (N.D. Cal. 2013), Judge

28 Koh simply declined to resolve at the class certification stage a conflict between the experts as to

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the proper method of disaggregating results. She did not find Murphy's opinion to be

"unreliable" or "inadmissible," but stated only that she did not find his method to be "more

credible" than the method offered by plaintiffs' expert—and thus that it did not require that class

certification be denied. *Id.* at 580.

In *United States v. Apple, Inc.,* Nos. 12 Civ. 2826 (DLC), 12 CIV 3394 (DLC), 2013 U.S.

Dist. LEXIS 96424 (S.D.N.Y. Oct. 4, 2013), Murphy proposed to offer an economic opinion as to

whether Apple's conduct was consistent with Apple's independent business interests. The court

did not rule on the validity of Murphy's economic analysis, but simply ruled that, as a legal

matter, whether Apple acted in independent interests was not relevant to finding a conspiracy and

that the expert evidence was unnecessary as to Apple's motivation and intent. None of these

rulings on legal issues has any bearing on the soundness of Murphy's opinions in this case on

econometric issues—or on validity of Noll's regression model.

CONCLUSION

Plaintiffs' motion should be denied, and Wooldridge's declaration should be excluded.

Dated: January 13, 2014   Respectfully submitted,

                                             Jones Day

                                             By: /s/ David C. Kiernan
                                                 David C. Kiernan

                                             Counsel for Defendant
                                             APPLE INC.

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