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9 UNITED STATES DISTRICT COURT  
10 NORTHERN DISTRICT OF CALIFORNIA  
11 SAN JOSE DIVISION

13 **THE APPLE IPOD iTUNES ANTI-  
14 TRUST LITIGATION**

Lead Case No. C 05-00037 JW (HRL)  
[Class Action]

**SECOND SUPPLEMENTAL REPORT  
OF DR. MICHELLE M. BURTIS**

15 \_\_\_\_\_  
16 This Document Relates To:  
17 ALL ACTIONS  
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1           4.       Professor Noll's inability to do so is understandable because, as he acknowledges  
2 at times, there is no economic theory that establishes that the challenged aspects of iTunes 7.0  
3 would necessarily affect iPod prices.<sup>1</sup> As I understand the record, it shows that even after iTunes  
4 7.0 was released in September 2006, consumers could still play RealNetworks' online digital  
5 music directly on every iPod purchased before that date.<sup>2</sup> They could also play RealNetworks'  
6 music on iPod models launched before that date even if purchased later. They could also play  
7 RealNetworks' music directly on new iPod shuffles launched after that date, because shuffles did  
8 not use the database and keybag verification codes challenged in this case as part of iTunes 7.0.  
9 Even though other iPod models introduced after September 2006 contained the challenged code,  
10 consumers could play RealNetworks' music on them by "burning" the music to a CD and  
11 "ripping" it to the iTunes jukebox application on their computer. In addition, as Professor Noll  
12 recognized before this case was limited to iTunes 7.0, disabling Harmony in September 2006  
13 could not have affected iPod pricing if consumers were not using Harmony at that time and he  
14 suspected they were not doing so.<sup>3</sup>

15           5.       As I understand it, Plaintiffs' theory is that some consumers were buying songs  
16 from RealNetworks as of September 2006 to play on iPods and that, as a result of the challenged  
17 aspects of iTunes 7.0, they could not directly play those songs on some models of iPods  
18 introduced thereafter. If that were true and if Plaintiffs' multi-step theory of how that would  
19 somehow increase iPod demand at some indeterminate future time were correct, it is still  
20 implausible that the relatively small change in demand would have made any difference in iPod  
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22 <sup>1</sup> Noll Supplemental Declaration, filed July 18, 2011, at 2 ("Whether Apple did set iPod prices  
23 above the level that otherwise would have been the case is an empirical matter to be determined  
24 by econometric analysis."); Roger Noll Deposition, April 7, 2011 ("Noll April 2011 Deposition  
25 Tr.") at 200:22-02:13 (as to whether economic theory can determine the initial net impact on iPod  
prices or when any positive impact would switch to negative, "it's purely an empirical question.  
It's not a theoretical question.").

26 <sup>2</sup> The facts in this paragraph are supported by Doc. 472, ¶¶ 31-32 (Farrugia Decl.); Doc. 506, ¶ 2  
27 (errata to Farrugia Decl.); Doc. 473, p. 10 (Apple's Renewed Motion for Summary Judgment);  
Doc. 663, p. 4 (Apple's Response to Professor Noll's July 18 Declaration).

28 <sup>3</sup> Noll April 2011 Deposition Tr. at 147:20-148:5.

1 prices. [REDACTED]

2 [REDACTED] This is a

3 further reason why the failure of Professor Noll's regressions to show any impact or damages is  
4 understandable. As Professor Noll has acknowledged, his regression does not account for the fact  
5 that Apple changed its retail and wholesale prices infrequently.<sup>4</sup> For example, the first price  
6 change after iTunes 7.0 was introduced in September 2006 was not until a year later when Apple  
7 launched new models. However, under Professor Noll's model (if it were otherwise robust and  
8 reliable), Apple supposedly would have changed prices every quarter and would have done so in  
9 smaller increments than it had ever done.

10 6. In a prior deposition, Professor Noll testified that his regression analysis with  
11 respect to iTunes 4.7 was unreliable, incomplete, had omitted variables, may be biased, may be  
12 affected by spurious correlation, did not take Apple's pricing strategy into account, and should  
13 not be used to draw any inferences about issues fundamental to the case, such as the price effect  
14 of the launch of the iTunes Store, the entry of Harmony, or the disabling of Harmony.<sup>5</sup> Professor  
15 Noll thus acknowledged that he could not make any "causal inferences" from the regression and  
16 that it did not provide any basis for a "conclusion" as to "whether the launch of Harmony or the  
17 disabling of Harmony had any effect on iPod prices."<sup>6</sup> Professor Noll's reseller regression model  
18 addressed to iTunes 7.0 is essentially the same model as he used with respect to iTunes 4.7, with  
19 the main difference being that he inserted a variable for iTunes 7.0 and changed the former  
20 iTunes 4.7 variable to turn off when iTunes 7.0 was launched. At his deposition last week,  
21 Professor Noll repeated his testimony that even the current version of his reseller regression did  
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23 <sup>4</sup> Noll April 2011 Deposition Tr. at 189:19-23 ("Q. Does your current regression in your reply  
24 report account for the fact that Apple changed its retail prices and wholesale prices, list prices  
infrequently? A. No, that's why it's not a damage model.").

25 <sup>5</sup> Expert Report of Dr. Michelle M. Burtis, filed April 11, 2011 ("April 2011 Burtis Report") at  
26 ¶ 7.

27 <sup>6</sup> Noll April 2011 Deposition Tr. at 92:22-23 ("I drew no causal inferences from that regression.");  
28 *id.* at 113:20-21 ("not reaching a conclusion [as to price effect of Harmony or disabling], and I do  
not know based on the information that I have that that conclusion is justified").

1 not reliably demonstrate impact or the amount of damages. He testified that, based on the  
2 regression analyses, he is “not willing to reach a conclusion on causality as to anticompetitive  
3 effects” of the challenged conduct, by which he means “whether the conduct had any impact on  
4 iPod pricing.”<sup>7</sup> He repeated that he has not “formed an opinion as to whether that conduct caused  
5 the retail iPod prices charged by Apple to be any different than they would have been without that  
6 conduct.”<sup>8</sup>

7         7. In his Second Supplemental Declaration, Professor Noll seeks to explain his earlier  
8 concession that he cannot draw any casual inferences from his regression by saying that he was  
9 simply avoiding offering “conclusions on the merits of plaintiffs’ allegations” and that proving  
10 “anticompetitive harm and damages” are legal matters “beyond [his] expertise.”<sup>9</sup> I do not see  
11 how he can square those assertions with the passages in his various declarations where he says  
12 that his regressions supposedly show that iTunes 7.0 caused iPod prices to increase—and it was  
13 those passages from which Professor Noll retreated at deposition when he testified that “I drew no  
14 causal inferences from that regression” and that he could not say “whether the launch of Harmony  
15 or the disabling of Harmony had any effect on iPod prices.”<sup>10</sup> That testimony was not couched in  
16 terms of legal expertise. Indeed, at his recent deposition he admitted that by “anticompetitive  
17 effects,” he simply means whether the challenged conduct caused iPod prices to increase.<sup>11</sup>

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20 <sup>7</sup> Roger Noll Deposition, Nov. 7, 2011 (“Noll November 2011 Deposition Tr.”) at 9:14-10:5.

21 <sup>8</sup> Noll November 2011 Deposition Tr. at 11:12-18. At the end of his new declaration, after  
22 describing some of the reasons why his retail regression is unreliable, Professor Noll writes:  
23 “Regardless of the accuracy of the point estimate of the coefficient for purposes of calculating  
24 damages, a coefficient that is positive with a high degree of statistical significance is proof that  
25 the prices of iPods were higher than otherwise would have been the case after the release of  
26 iTunes 7.0.” Second Supplemental Noll Declaration at 36. If, as Professor Noll concedes, the  
27 value of the coefficient for the 7.0 variable is not accurate, there is no basis to conclude that a  
28 reliable regression would end up with a statistically significant, positive coefficient. It could just  
as well end up with a statistically insignificant coefficient or a negative one.

<sup>9</sup> Second Supplemental Noll Declaration at 6, 28.

<sup>10</sup> Noll April 2011 Deposition Tr. at 92:22-23, 113:12-17.

<sup>11</sup> Noll November 2011 Deposition Tr. at 9:25-10:5.

1           8.       As a practical matter, the defects in his approach can be illustrated by seeing what  
2 happens to the results when some variables are removed or added. Everyone considers cost to be  
3 an important indicator of price. But when the cost variable is removed from Professor Noll's  
4 regression, the regression still purports to give statistically significant results. And when  
5 variables are added for random events that clearly have no bearing on iPod pricing such as former  
6 Vice President Cheney's hunting accident and the move of soccer star David Beckham to a new  
7 team, the regression attributes statistically significant effects on iPod prices to these random  
8 events *See* paragraph 39 below. Likewise, adding a single, arguably important variable (such as  
9 iTunes 8.0) to the reseller model changes the claimed result for the iTunes 7.0 variable from  
10 positive (and allegedly statistically significant) to negative (and allegedly statistically significant).  
11 *See* paragraph 49 below. This fragility or sensitivity indicates a fundamental lack of reliability  
12 and the inability to draw reliable statistical inferences based on the proposed method.

13           9.       Professor Noll now presents, for the first time, a separate "preliminary" regression  
14 analysis purportedly addressing Apple's retail iPod prices. This retail regression suffers from the  
15 same infirmities as his reseller regression. Both are inadequate to assess impact and damages  
16 under Plaintiffs' complex theory of harm. Neither is not a proper specification of Apple's iPod  
17 pricing methodology. Neither reflects how Apple sets iPod prices at product launch, and then  
18 rarely changes them until new products are launched, or the product enters end-of-life. Neither  
19 includes many of the variables that capture the relevant factors that Apple considers when setting  
20 prices. If, contrary to fact, they were robust and showed an overcharge, each would produce only  
21 a single, average overcharge that would be applied to all iPod products, regardless of model,  
22 class, generation, time period of purchase, and price. They ignore that certain iPod products  
23 (such as the shuffle, the nano, and the touch) were not sold in both the before Harmony and after  
24 Harmony periods and therefore overcharges cannot be separately estimated. They fail to separate  
25 the effects, if any, of the alleged conduct from the confounding effects of other events that  
26 occurred at the same time including the other features introduced with iTunes 7.0, for example.  
27 They depend on datasets that are particularly ill-suited to the purpose for which they are being  
28 used, because they do not show sufficient variation, and Professor Noll has failed to attempt to

1 correct for it. If he did, the results of his regressions would lose any statistical significance. See  
2 paragraphs 40-48 below.

3 **DISCUSSION**

4 **Professor Noll's Proposed Methodology Does Not Account for Apple's Price Setting**

5 **Methodology**

6 10. Professor Noll's proposed methodology is based on the assumption that Apple  
7 regularly adjusts its iPod prices in small increments as market conditions change and that the  
8 effects of these changing conditions can be captured statistically with various dummy variables.

9 [REDACTED]

10 [REDACTED]

11 11. [REDACTED]

12 [REDACTED]

13 13 [REDACTED]

14 [REDACTED]

15 14 [REDACTED]

16 [REDACTED]

17 [REDACTED]

18 [REDACTED]

19 [REDACTED]

20 [REDACTED]

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23 [REDACTED]

24 12 [REDACTED]

25 [REDACTED]

26 <sup>13</sup> Mark Donnelly Deposition, Dec. 20, 2010 ("Donnelly Deposition Tr.") at 46:1-47:2.

27 <sup>14</sup> Donnelly Deposition Tr. at 20:5-23.

28 <sup>15</sup> Donnelly Deposition Tr. at 49:21-50:12.

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[REDACTED] 16 [REDACTED]  
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12. In his Second Supplemental Declaration, Professor Noll states that he observes price variation from quarter to quarter in his retail data, when list prices do not change.<sup>18</sup> However, he asserts that the data he is using has a number of problems, and he admits that using it to calculate quarterly prices “may be inaccurate.”<sup>19</sup> For example, the data is net of returns, and averages out any price changes that might occur mid-quarter.<sup>20</sup> Professor Noll cites to no evidence that Apple sold any significant number of iPods at retail at any other price than the announced retail price. Professor Noll could have used Apple’s announced retail prices, but instead chose to use his “inaccurate” data.

13. [REDACTED]

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16 [REDACTED]

17 [REDACTED]

<sup>18</sup> Second Supplemental Noll Declaration at 35.  
<sup>19</sup> Second Supplemental Noll Declaration at 34.  
<sup>20</sup> See Exhibit 8 below for an example.



1 [REDACTED]  
2 [REDACTED]<sup>21</sup> None of these variables are included in Professor Noll's models and no  
3 plan for including such variables has been articulated. Without such variables, the proposed  
4 models cannot explain introductory prices.

5 14. Rather than include variables that capture the factors Apple considers, Professor  
6 Noll's models rely primarily on dummy variables and generic time trends. These variables  
7 simply separate the various iPod models into different categories and calculate the average price  
8 differences between categories. They do not explain the price differences based on the  
9 underlying economic factors that led to them. For example, the proposed reseller model reports  
10 the calculated price difference between an iPod nano 1GB and an iPod nano 2GB in July 2006,  
11 but it does not capture the economic variables that led to that price difference. [REDACTED]

12 [REDACTED]  
13 [REDACTED]  
14 [REDACTED]<sup>22</sup> While Professor Noll's regressions do  
15 include a single cost variable, that variable does not capture the breadth of factors considered by  
16 Apple.

17 15. Further, Professor Noll's dummy variables do not capture factors that might  
18 change between the "before" period and the "after" (or during) period in his regressions. A  
19 critical consideration in the use of a before-after model, such as Professor Noll's models, is that  
20 the relevant factors that affect price be properly accounted for so that any price difference  
21 between the before period and the after period is not falsely ascribed to the alleged conduct. For  
22 example, if there is some different relationship between iPod prices and cost before and after the  
23 iTunes 7.0 update (or before and after some other event considered or not considered in the  
24 model) and that changed relationship is not taken into account in the model, then its impact could  
25 be falsely attributed to the update. Because Professor Noll's models do not contain those factors,

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27 <sup>21</sup> Donnelly Deposition Tr. at 59:16-60:24, 72:9-74:5.

28 <sup>22</sup> Donnelly Deposition Tr. at 67:4-69:12.

1 or even test for their existence, they cannot establish that any asserted overcharge is not actually  
2 due to a change in the factors relevant to Apple's pricing, rather than to the alleged conduct.

3 16. [REDACTED]

4 [REDACTED]  
5 <sup>23</sup> This is a fatal defect in Professor Noll's models.  
6 [REDACTED]  
7 [REDACTED]

8 Professor Noll's models do not account for  
9 these factors. Nor does Professor Noll describe how the models could be extended or changed to  
10 incorporate them. Indeed, the models make no attempt to explain these prices, but instead rely on  
11 dummy variables that simply separate the end-of-life transactions from other transactions.

12 17. The flaw in Professor Noll's proposed methodology can be seen by comparing  
13 actual prices with prices predicted by the model. Exhibit 2 compares the actual reseller prices of  
14 the iPod shuffle, first generation 512 MB, with the prices of that product predicted by Professor  
15 Noll's reseller regression. The graph shows that the prices predicted by the model change  
16 frequently, going both up and down at various points in time. By contrast, the actual prices  
17 follow Apple's pricing strategy: they are constant over time (the initial price does not change  
18 contrary to Noll's prediction), they do not vary across reseller customers, and they do not rise  
19 (they always fall). The graph demonstrates how Professor Noll's proposed methodology, based  
20 on the premise that Apple's prices change frequently and in small increments, is disconnected  
21 from Apple's actual prices. There is no evidence or reason to believe that, absent the alleged  
22 conduct in this case, Apple would have abandoned its fundamental pricing strategy and engaged  
23 in the kind of frequent, short-term price movements that Professor Noll's model predicts.

24 18. The model's finding that iTunes 7.0 led to higher iPod prices likewise results from  
25 a misspecified model. Exhibit 3 shows the reseller and retail iPod prices of all the iPod products  
26 sold around the time of the iTunes 7.0 launch. As can be seen, in all cases, iPod prices either fall

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28 <sup>23</sup> Donnelly Deposition Tr. at 50:13-53:25, 54:20-55:7.

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or do not change. No iPod prices increased when iTunes 7.0 was introduced.

[REDACTED]

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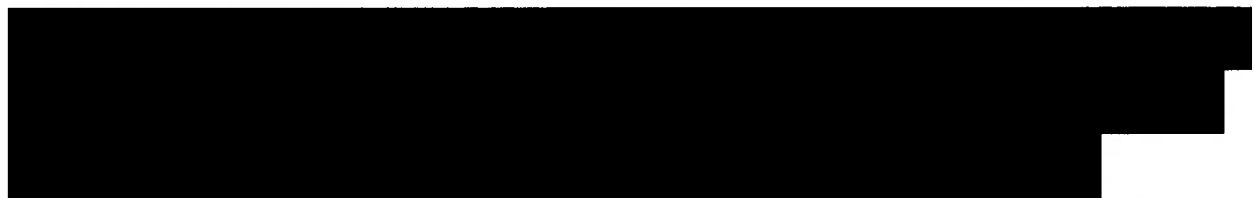
<sup>24</sup> Donnelly Deposition Tr. at 73:21-74:7.

<sup>25</sup> Second Supplemental Noll Declaration at Exhibit 1B.

<sup>26</sup> [REDACTED]

<sup>27</sup> Second Supplemental Noll Declaration at 12.

<sup>28</sup> Supplemental Noll Declaration at Exhibit 1.



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4 **Professor Noll’s Proposed Methodology Cannot Determine Whether Any Impact Occurred**  
5 **Because It Ignores Relevant Factors And Confounds Others**

6           21. Professor Noll’s proposed models assume that market events, such as the  
7 introduction of the iTunes Store, the iTunes 4.7 update, and the iTunes 7.0 update caused iPod  
8 prices to change. Given that assumption, the models should include other events that similarly  
9 may have caused iPod prices to change. For example, Apple added numerous new services to the  
10 iTunes Store, including the ability to rent or buy movies and television programs, and it added  
11 other significant content, including sporting highlights and free content.<sup>29</sup> Moreover, there were  
12 other software updates to iTunes that may have had an effect on demand for iPods. In September  
13 2008, Apple introduced iTunes 8.0, which included the Genius feature, which let users  
14 automatically create playlists from songs in their music library. Apple marketed Genius as  
15 enabling “music fans [to] rediscover favorite songs in their existing music library and [to] suggest  
16 related music on the iTunes Store they might want to add to their music collection.” In addition,  
17 iTunes 8.0 featured new ways of viewing music and video libraries, and added television  
18 programs in high definition for sale on the iTunes Store.<sup>30</sup> Professor Noll’s proposed method  
19 here does not distinguish any impact due to these events from any impact due to iTunes 7.0.

20           22. Professor Noll’s models also do not account for the aspects of iTunes 7.0 other  
21 than disabling Harmony that may have affected demand for iPods. Apple’s press release  
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23 <sup>29</sup> See “NFL & Apple Offer 2006 NFL Highlights on the iTunes Store, Apple,” Apple, Inc. Press  
24 Release, September 12, 2006, describing Apple introducing NFL highlights available on ITS;  
25 “Lionsgate Movies Now on iTunes,” Apple, Inc. Press Release, February 12, 2007, describing  
26 Apple introducing Lionsgate movies available on ITS; “HBO & Apple Bring Critically  
27 Acclaimed Television Programming to the iTunes Store,” Apple, Inc. Press Release, May 13,  
28 2008, describing Apple introducing HBO content available on the iTunes Store; and “Apple  
Announces iTunes U on the iTunes Store,” Apple, Inc. Press Release, May 30, 2007, describing  
Apple introducing iTunes U, that included free content.

<sup>30</sup> “Apple Announces iTunes 8,” Apple, Inc. Press Release, September 9, 2008.

1 describes iTunes 7.0 as “the most significant enhancement to the world’s most popular music  
2 jukebox and online music and video store since it debuted in 2001,” with features such as new  
3 album cover views of music, TV shows, movies with better browsing capability and videos with  
4 “near DVD” quality.<sup>31</sup> At least some of these additional features would directly enhance the  
5 value of iPods by providing new or better content to be played on the iPod. Professor Noll’s  
6 dummy variable approach is not capable of separating any impact on iPod demand and prices  
7 from these factors from the alleged effect iTunes 7.0 had in disabling Harmony. The effects of  
8 these multiple, simultaneous events are confounded, or combined, in his regression, with the  
9 result that the regression cannot measure any separate impact of the alleged conduct.<sup>32</sup>

#### 10 **Market Data Undermines Plaintiffs’ Theory That iTunes 7.0 Had Any Effect On iPod**

##### 11 **Prices**

12 23. Plaintiffs’ theory of impact from iTunes 7.0 is that, before being disabled by  
13 iTunes 7.0, RealNetworks Harmony technology was drawing customers away from the iTunes  
14 Store and would have continued to do so, thereby reducing the amount of iTunes Store songs in  
15 those customers’ music libraries and reducing the degree to which they were allegedly locked into  
16 buying iPods. Plaintiffs assert that, as result of this reduced lock-in, demand would be reduced  
17 for iPods and iPod prices would decrease. The validity of this theory thus depends at the  
18 threshold on the notion that RealNetworks was in fact drawing away customers from the iTunes  
19 Store and would have continued to do so in sufficiently large numbers to meaningfully impact  
20 demand for iPods.<sup>33</sup> To the extent that RealNetworks did not achieve any significant sales  
21 volume from its RealPlayer Music Store, or its sales were to consumers who would not have  
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23 <sup>31</sup> “Apple Announces iTunes 7 with Amazing New Features,” Apple, Inc. Press Release,  
24 September 12, 2006.

25 <sup>32</sup> Professor Noll admitted at his deposition that other aspects of the iTunes 7.0 update, including  
26 new movies, album cover views of music and video games, could plausibly affect iPod demand.  
Noll November 2011 Deposition Tr. at 112:1-5, 114:13-115:16.

27 <sup>33</sup> If such sales are believed to have been diminished by the legal effects of iTunes 4.7 disabling  
28 Harmony, then the marginal impact of any further disabling of Harmony by iTunes 7.0 would be  
expected to be low.

1 purchased from the iTunes Store in any event, Plaintiffs' theory of harm fails from the outset, and  
2 (assuming his model were otherwise valid) any measured effect of iTunes 7.0 on iPod prices  
3 would presumably be due to other confounding factors, and not from any disabling of Harmony.

4 24. Professor Noll, however, presents no evidence or reason to believe that  
5 RealNetworks was drawing customers away from the iTunes Store and would have continued to  
6 do so absent iTunes 7.0—let alone that it was doing so in sufficiently large numbers to have had  
7 any significant effect on overall demand for iPods. To the contrary, the available evidence  
8 indicates that RealNetworks sales were not sufficient to have any such effect.

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21 **Professor Noll's Proposed Models Can Find Only Average Overcharges**

22 26. As described in my previous report, Professor Noll's reseller regression returns a  
23 single estimated effect from iTunes 7.0 that is an average across all iPod models and purchasers  
24 for the entire class period. His retail regression does the same. Professor Noll does not attempt to  
25 defend this as a valid measure of the impact or damages suffered by any particular class  
26 member.<sup>34</sup> Nor could he, as it is self-evident (even assuming his model was otherwise valid) that

27 \_\_\_\_\_  
28 <sup>34</sup> Second Supplemental Noll Declaration at 6 ("First, I do not offer conclusions on the merits of  
(continued)

1 any effect from iTunes 7.0 would not be a single dollar amount for every single iPod. Professor  
2 Noll himself has admitted that the impact, if any, from iTunes 7.0 would be felt only in the long  
3 run and thus would not occur uniformly throughout the entire class period.<sup>35</sup>

4 27. Professor Noll asserts that he can address this problem by using a “logarithmic  
5 form of the regression” or by adding “interactions” between the iTunes 7.0 variable and other  
6 variables.<sup>36</sup> Professor Noll has not produced any models using either of these techniques. Nor  
7 has he established that either technique would work.

8 28. As to a logarithmic model, if Professor Noll is describing a specification in which  
9 the value of prices are in logarithmic form, such a model would return the same percentage  
10 overcharge for all models, and any overcharges would differ only because iPod models’ prices  
11 differ. So, instead of one average overcharge expressed in dollars, as in Professor Noll’s current  
12 model, there would be one average overcharge expressed in percentage terms. That percentage  
13 would produce different overcharge amounts in dollars only because iPod products have different  
14 prices.

15 29. This proposed logarithmic model does not solve the problem. Competitive  
16 conditions for different iPod models differ, and differ over time, and (even if Plaintiffs’ theory  
17 were otherwise valid) there is no reason to expect there to be a constant percentage overcharge  
18 across all models, and over the entire class period. In addition, the assumption of a single  
19 percentage overcharge is not consistent with Plaintiffs’ theory that any price impact would be felt  
20 gradually over time as Apple’s market power gradually eroded in the face of competition from the  
21 RealNetworks music store.

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24 plaintiffs’ allegations, and do not claim that my regressions can be used to calculate damages.”);  
25 *id.* at 7 (“Because the estimated prices may not be actual prices due to the unknown effect of  
26 returns, this regression cannot be used to calculate damage.”); *id.* at 31 (“This analysis is  
27 preliminary due to limitations in the data that Apple has produced.”); *id.* at 35-36 (“Again,  
28 estimated effect of the release of iTunes 7.0 in this regression cannot be interpreted as an estimate  
of damages, even assuming that the liability allegations of the plaintiffs have been proved.”).

<sup>35</sup> Declaration of Roger G. Noll, filed Jan. 18, 2011, at 54 (Doc. 497).

<sup>36</sup> Second Supplemental Noll Declaration at 13.

1           30.     As for Professor Noll’s suggestion that he could add new variables that are  
2 “interactions,” between the iTunes 7.0 dummy variable and other variables in the equation,  
3 Professor Noll does not offer any explanation to support the propriety of that approach here.  
4 Professor Noll is apparently proposing that, instead of including a single variable for the iTunes  
5 7.0 update, he could include different iTunes 7.0 variables for each different iPod model (such as  
6 the iPod nano, shuffle, etc.). Including such separate iTunes 7.0 variables, alone, however, will  
7 not work because the iPod touch was not sold in the before period. I discuss below a similar issue  
8 with the iPod nano and shuffle, which were not sold prior to the launch of iTunes 4.7. In an  
9 attempt to circumvent this problem, Professor Noll appears to suggest “interacting” separate  
10 iTunes 7.0 dummy variables with the trend variable that is already in his equation.<sup>37</sup> The trend  
11 variable after the launch of iTunes 7.0 would be different for each iPod model and thus would  
12 allow estimation of the regression. However, such a specification implies that any estimated  
13 effect of iTunes 7.0 would be that the trend in each iPod model’s prices changed, rather than the  
14 level. As described above, Apple does not price in this manner. Apple does not change iPod  
15 prices regularly over time (such as at weekly, or monthly intervals) as would be the case with  
16 such a trend variable. Thus, specifying a regression model to look for such a pattern within each  
17 iPod model, and how it might have changed with the launch of iTunes 7.0, is a fundamental  
18 misspecification.

19           31.     Moreover, this suggested specification is a significant departure from the  
20 regression model presented. If the effect of iTunes 7.0 is believed to be a change in price trend,  
21 then a fully specified model would, presumably, have to capture differences in price trends for  
22 other events, such as the introduction of the iTunes Store, the iTunes 4.7 update, competitors and  
23 Apple’s introduction of DRM-free music, as well as other possible events that are not currently  
24 included in the model. Professor Noll does not attempt to show that such a model, based on this  
25 different underlying assumption of impact, would work. A fully specified model along these  
26 lines would not be able to estimate a separate effect of iTunes 7.0 on the iPod touch because again

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28 <sup>37</sup> Second Supplemental Noll Declaration at 13.



1 there are no sales in the before period. There is no way to estimate both an iPod touch trend  
2 variable and a variable that shows how this trend changes after the launch of iTunes 7.0. In the  
3 next section I discuss how a similar problem exists for the iPod nano and iPod shuffle.

4 **Professor Noll has Not Shown that His Model Can Validly Estimate Impact for iPod Models**  
5 **Sold Only After October 2004**

6 32. Professor Noll acknowledges that his regression models cannot directly estimate  
7 separate overcharges due to iTunes 7.0 for certain models, such as the iPod touch, that were not  
8 sold before September 2006.<sup>38</sup> He argues that his current methodology instead presumes impact  
9 on purchasers of the iPod touch, based on how “Apple’s pricing structure in general was altered  
10 by the presence of iTunes 7.0.”<sup>39</sup> His newly articulated interpretation of the iTunes 7.0 variable  
11 further implies that his methodology also cannot establish impact on iPod products that were first  
12 sold after the launch of iTunes 4.7 in October 2004. This includes the iPod nano and the iPod  
13 shuffle, in addition to the iPod touch.

14 33. Professor Noll claims that his presumption of impact is valid because he used a  
15 hedonic regression that explained “the difference in price between products (for example, an iPod  
16 touch and an iPod nano) on the basis of difference in attributes.”<sup>40</sup> He asserts that the “resulting  
17 equation links the prices of different classes of iPods through time.”<sup>41</sup> However, Professor Noll  
18 has fallen well short of modeling the differences between the different iPod products. He has  
19 improperly pooled together very different products and modeled only a select few of the  
20 characteristics and features that differentiate those products. Some of the attributes not captured  
21 by Professor Noll are the availability on the iPod touch of “apps” that range from the Angry Birds  
22 video game to Facebook, and the ability of some iPod nano models to receive FM radio and  
23 communicate with fitness chips placed in running shoes. The availability of competitors’  
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25 <sup>38</sup> Second Supplemental Noll Declaration at 14.

26 <sup>39</sup> Second Supplemental Noll Declaration at 14-15.

27 <sup>40</sup> Second Supplemental Noll Declaration at 14.

28 <sup>41</sup> Second Supplemental Noll Declaration at 14.

1 products also differ across the different iPod models.<sup>42</sup> It is not credible that any effect of the  
2 launch of iTunes 7.0 (if any existed at all) would be commonly felt by all iPod products.

3 34. Though the iPod nano and the iPod shuffle were sold both prior to, and after, the  
4 launch of iTunes 7.0, they were not sold both prior to, and after, the launch of iTunes 4.7.  
5 Professor Noll argues that the proper interpretation of the effect of iTunes 7.0 is relative to a  
6 benchmark that removes any effect of iTunes 4.7.<sup>43</sup> Thus, to draw a separate inference about the  
7 effect of iTunes 7.0 on a particular iPod model, both the effect of iTunes 4.7 and iTunes 7.0 must  
8 be measured. Under Professor Noll's interpretation, because the effect of iTunes 4.7 cannot be  
9 separately measured for the iPod nano and the iPod shuffle, for these products there is no way to  
10 separately establish if an estimated coefficient on the iTunes 7.0 variable represents only the  
11 alleged effect of iTunes 7.0, as opposed to also including an effect from Apple's lawful adoption  
12 of iTunes 4.7. Separate overcharges due to iTunes 7.0 cannot be ascertained for either product.<sup>44</sup>

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18 <sup>42</sup> [REDACTED]

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22 <sup>43</sup> Second Supplemental Noll Declaration at 10. I discuss this interpretation in more detail below.

23 <sup>44</sup> These same criticisms apply to the models proposed (but not provided) by Professor Noll where  
24 the iTunes 7.0 variable is proposed to be interacted with iPod class variables and the time trend.  
25 As I have discussed, such a model rests on the mistaken view that Apple's pricing frequently  
26 changes over time, and in response to changing market conditions. Regardless of the validity of  
27 this assumption, it remains the case that, if the suggestion is that the trend in different iPod  
28 models' prices changed before and after the iTunes 7.0 update, then the trend in each model's  
price must be measured before and after the update. Once again, this is not possible for the iPod  
touch because there is no trend in its price before the iTunes 7.0 update. This is similarly true for  
the iPod nano and iPod shuffle with regard to the iTunes 4.7 update. This is a fundamental  
problem with the before and after approach for products not sold in the before period.

1 **Professor Noll has Incorrectly Interpreted the Results of His Regression: Properly**  
2 **Interpreted, the Measured Impact of iTunes 7.0, if any, is Negative**

3 35. Professor Noll argues that the proper specification of the iTunes 4.7 variable is that  
4 it “be reset to zero” when iTunes 7.0 is launched.<sup>45</sup> With this specification, he argues, the  
5 interpretation of the estimated coefficient on the iTunes 7.0 variable is that it is the effect on iPod  
6 prices from iTunes 7.0’s disabling of Harmony. In my previous report I noted that resetting the  
7 iTunes 4.7 variable to zero was inconsistent with the way Professor Noll modeled other, similar  
8 variables. In his Second Supplemental Declaration, Professor Noll now argues that this criticism  
9 is “irrelevant if the coefficients on the indicator variables are interpreted properly.”<sup>46</sup> He states:  
10 “the proper interpretation of Dr. Burtis’s proposed regression [where the iTunes 4.7 variable is  
11 not reset to zero] is that the effect of iTunes 7.0 would be the sum of the coefficients of the two  
12 variables [the iTunes 4.7 indicator variable and the iTunes 7.0 indicator variable].”<sup>47</sup>

13 36. Professor Noll is correct that the structure of the iTunes 4.7 variable (reset to zero  
14 or not) is unimportant if it is interpreted correctly. However, Professor Noll’s interpretation of  
15 these results is incorrect. His interpretation, that the effect of iTunes 7.0 is a continuation of the  
16 effect of iTunes 4.7, but at a reduced level, is based on a misunderstanding of the relevant but-for  
17 world. He considers the effect of iTunes 7.0 relative to a world *without iTunes 4.7*. This is not a  
18 correct characterization of the but-for world. The court has ruled that iTunes 4.7 was lawful.  
19 iTunes 4.7 thus would have existed in the but-for world. The correct comparison is therefore to  
20 compare the effect of iTunes 7.0 relative to the legal effect of iTunes 4.7.<sup>48</sup> If the allegedly  
21 harmful part of iTunes 7.0 (the part that blocked Harmony) were removed, as it would be in the  
22 Plaintiffs’ but-for world, the part of iTunes 4.7 that blocked Harmony, and was found to be

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24 <sup>45</sup> Second Supplemental Noll Declaration at 10.

25 <sup>46</sup> Second Supplemental Noll Declaration at 10.

26 <sup>47</sup> Second Supplemental Noll Declaration at 10.

27 <sup>48</sup> According to Professor Noll’s testimony, if the price of an iPod product was \$250 prior to the  
28 iTunes 4.7 update, the price “but for” iTunes 4.7 is \$250 minus \$6.54 and the price “but for” 7.0  
is \$250 minus \$4.85. Noll November 2011 Deposition Tr. at 108:5-109:5. This means that,  
given the iTunes 4.7 update was lawful, the iTunes 7.0 update reduced price, not increased it.

1 lawful, would remain. Thus, its impact on iPod prices would remain. If Professor Noll's  
2 proposed models were otherwise valid (which they are not), the relevant effect of iTunes 7.0  
3 would be measured relative to iTunes 4.7. As I illustrated in my prior Declaration, Professor  
4 Noll's reseller regression shows this effect to be negative. See Exhibit 5 for an illustration. His  
5 retail regression (which is invalid for all of the other reasons explained in my report) shows this  
6 effect to be slightly positive (\$1.78).

7 **Professor Noll's Statistical Measures Do Not Show that His Model is Reliable**

8 37. Professor Noll has asserted that his regression models return "very precisely  
9 estimated" coefficients and that the equations' "fit" is "very high."<sup>49</sup> He relies for this assertion  
10 on the fact that the standard errors of the coefficients in his models are low and the models have a  
11 high R-squared value. These statistical measures, however, do not show that the models' results  
12 are reliable or establish any anticompetitive effect.

13 38. A regression analysis that returns estimates that are not precise or that do not fit  
14 the underlying data well will be of questionable value. The high standard errors or a low R-  
15 squared value show that the model may not be reliable. However, the converse is not true. It is  
16 well known that defending a regression specification based on a high R-squared or low standard  
17 errors is not an appropriate or reliable practice.<sup>50</sup>

18 39. Professor Noll's testimony demonstrates these principles. He has testified that the  
19 regression analyses produced thus far are only "provisional," and are not necessarily reliable,  
20 even though the R-squared statistics indicate the data "fit" the model and the estimates are

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22 <sup>49</sup> Supplemental Noll Declaration at 4; Second Supplemental Noll Declaration at 7.

23 <sup>50</sup> See, for example, Peter Kennedy, *A Guide to Econometrics*, Blackwell Publishing, 6th Edition  
24 at p. 27 ("In general, econometricians are interested in obtaining 'good' parameter estimates  
25 where 'good' is not defined in terms of  $R^2$ . Consequently the measure of  $R^2$  is not of much  
26 importance in econometrics."); p. 89 ("It is worth reiterating that searching for a high  $R^2$  or a high  
27 [adjusted]  $R^2$  runs the real danger of finding, through perseverance, an equation that fits the data  
28 well but is incorrect because it captures accidental features of the particular data set at  
hand...rather than the true underlying relationship."); and p. 84 ("Both searching for high  $R^2$  and  
searching for high t values are known to be poor mechanisms for model choice; convincing  
arguments can found in T. Mayer (1975,1980), Peach and Webb Webb (1983), and Lovell  
(1983).")").

1 “precisely” estimated. That his statistical measures do not mean his models are reliable can be  
2 further demonstrated by removing variables from Professor Noll’s model that, according to him,  
3 are important to explaining Apple’s prices. Professor Noll identifies cost as one such variable.  
4 He claims “81 percent of the cost difference between two iPods is reflected in their price  
5 difference.”<sup>51</sup> Removing this variable from Professor Noll’s regression, however, only slightly  
6 changes the R-squared (from 97.7 to 96.1), which means the “fit” remains “high.” Similarly, the  
7 reported standard errors also change only slightly.<sup>52</sup> Conversely, coefficients measuring the  
8 impact of events that clearly do not matter to iPod pricing may be found to be highly significant,  
9 and “precisely” estimated. For example, adding variables to Professor Noll’s models for former  
10 Vice President Cheney’s hunting accident and David Beckham’s move to the Los Angeles Galaxy  
11 results in co-efficients that are statistically significant in Professor Noll’s model and therefore  
12 “precisely” estimated, when clearly they are not important to iPod pricing.<sup>53</sup>

13 **Professor Noll’s Results are Unreliable Due to Incorrect Assumptions About the**  
14 **Independence of Data Observations**

15 40. A fundamental problem in the proposed regressions is that the underlying data (for  
16 example, iPod prices) has very little variation, or change (observation to observation). This is  
17 important because regression analysis works by correlating changes in one variable to the changes  
18 in other variables. Consider a regression that attempts to explain the price of gasoline charged by  
19 a retail outlet. Over the course of a month, the owner does not change the price of gasoline. A  
20 regression analysis, using data for this month, cannot identify the factors that explain this owner’s  
21 gasoline prices. Even if other variables, such as cost or competitors’ prices also remain constant  
22 over the month, the information is insufficient to conclude that those variables are determining  
23 the gasoline prices. However, if gasoline prices do change over the course of the month and cost  
24 also changes, some relationship between price and cost may be statistically estimated. If price  
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26 <sup>51</sup> Reply Noll Declaration at 38.


27 <sup>52</sup> See Exhibit 6.

28 <sup>53</sup> See Exhibit 7.

1 changes when cost changes, and price remains constant when cost is constant, then the regression  
2 analysis will find some relationship between the two variables. The more changes there are in the  
3 underlying data, the more information there is about the relationship between the variables and  
4 the better, or more precise, the estimates.

5 41. While Professor Noll's data contains relatively little variation, it does, in the case  
6 of the reseller data, contain a relatively large number of observations. The number of  
7 observations is a key determinant in the formula for calculating standard errors in a regression  
8 analysis. All else equal, a regression analysis with more observations will produce lower  
9 standard errors. (For example, if a regression is estimated for a certain data set and then the data  
10 set is repeated many times and the regression is re-estimated with the repeated data set, the results  
11 of the estimation with the repeated data set will indicate lower standard errors. While no new  
12 information is introduced by repeating the data set, the results appear to generate better or more  
13 precise estimates.) This phenomenon occurs simply because of the formula used to calculate  
14 standard errors. When there is little variation in the underlying data, but there is a substantial  
15 number of observations, the calculated standard errors may produce results that show "precisely"  
16 estimated coefficients, when in fact there is no such precision.

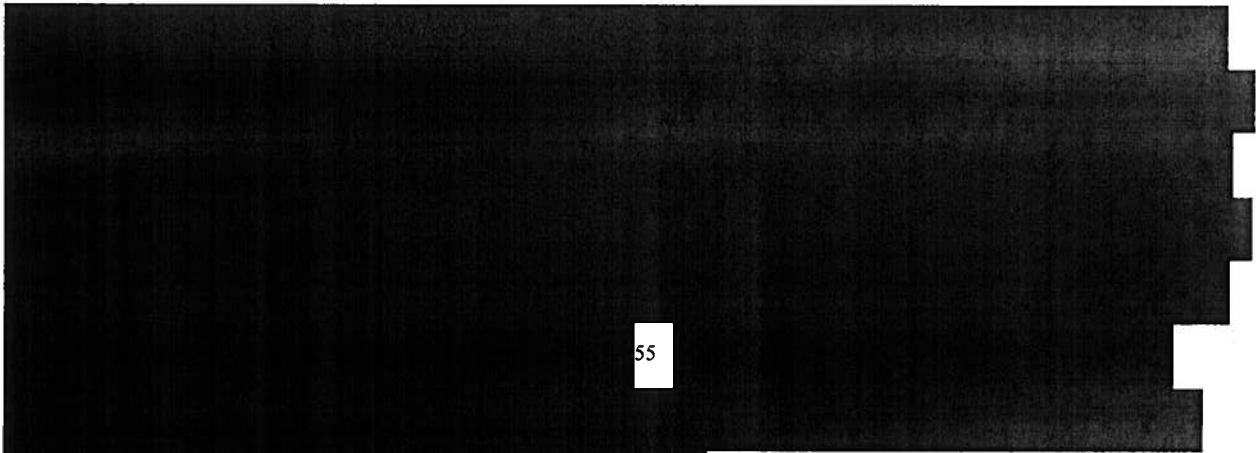
17 42. An important underlying assumption of reliably calculated standard errors is that  
18 the regression "residuals," or what is not explained by the variables in the equation, are  
19 independent from one another. These residuals are sometimes called regression errors, and there  
20 is a separate such error for each observation in the data set. (These are different from standard  
21 errors, which are associated with the coefficients estimated in a regression.) If the regression  
22 residuals or errors are not independent, then the standard calculations of coefficient's standard  
23 errors are inaccurate. Evidence that regression errors are not independent is that the errors are  
24 correlated. Such correlation is likely to exist when there is little variation in the underlying data.

25 43. In the reseller regression, Professor Noll claims to have over two million  
26 observations. However, there are only 476 different prices. 

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<sup>56</sup> Professor Noll argues that, even though the price in each transaction was identical, the prices were nonetheless independent because each transaction represented a separate decision, presumably by Apple and each customer. The issue, however, is what factors lead to changes in Apple’s prices. Even if the decisions by different customers are independent decisions, no incremental information is generated when the same price to each customer is included in the regression. Moreover, no basis exists in any event for assuming that, for each day for each reseller, Apple independently considers whether to sell an iPod at the same price it did the day before to the same customer and whether to sell an iPod to one customer at the same price as some other customer.



<sup>56</sup> Professor Noll attempts to dismiss this problem, claiming that “economists frequently use data sets with many transactions at the same price...” He references an article related to retail prices at grocery stores. Professor Noll apparently assumes that this data contains “many transactions at the same price,” concluding that “...the price of any specific grocery item was likely to be identical in all sales, but differences in the identity of the purchaser and the quantity purchased made each transaction a valid observation.” Second Supplemental Noll Declaration at fn. 2. However, examination of the article indicates the data set was not at the level of the individual purchaser and therefore would not have contained any differences in the identity of the purchaser or the quantity purchased. The dataset used in the study was at the “level of individual retail stores,” not the level of individual consumers purchasing at the store. See Emi Nakamura, “Pass-Through in Retail and Wholesale,” *American Economic Review: Papers & Proceedings* 2008, 98:2, 430-437 at 430.

1 [REDACTED]  
2 [REDACTED]  
3 44. The lack of independent errors in Professor Noll's regression is even more severe,  
4 however, because the lack of variation is not limited to the prices used in the regression, but  
5 extends to the values of the explanatory variables, as well. The regression errors for two  
6 observations with the same price and the same values of explanatory variables will not simply fail  
7 to be independent; they will be identical. [REDACTED]

8 [REDACTED]  
9 [REDACTED]  
10 57 [REDACTED]  
11 [REDACTED]  
12 [REDACTED]  
13 [REDACTED] This identity of the  
14 errors means that the regression errors clearly are not independent, which means that the low  
15 standard errors Professor Noll reports are not a valid indicator that his model is reliable.<sup>58</sup> As  
16 discussed above, if the regression errors (the portion of the data (here prices) unexplained by the  
17 regression model) are not independent but are positively correlated across observations, say  
18 within a group (such as the transactions for a particular iPod model sold during a particular period  
19 of time), and there is no accounting for that correlation, then the standard errors will be incorrect;  
20 they will appear to be small, when in fact, they are not. In other words, the precision of the  
21 estimated coefficients will be overstated.<sup>59</sup> Professor Noll acknowledges the importance of this

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23 57 [REDACTED]  
24 [REDACTED]

25 <sup>58</sup> "A pillar of traditional cross section inference ... is the assumption that the data are  
26 independent. Each observation is treated as a random draw from the same population,  
27 uncorrelated with the observation before or after... The most important form of dependence  
28 arises in data with a group structure." Angrist, Joshua D. and Jorn-Steffen Pischke, *Mostly  
Harmless Econometrics*, Princeton University Press, 2009, p. 292-3 ("*Mostly Harmless  
Econometrics*").

<sup>59</sup> The problem becomes particularly severe when the regression errors are exactly the same, or  
(continued)



1 fundamental assumption underlying the statistical analysis, but does not acknowledge that the  
2 dataset he uses violates the assumption.<sup>60</sup>

3 45. This issue, called group random effects or clustering, is well known in the  
4 econometrics literature *and applies to regression analysis*. While Professor Noll professes not to  
5 understand how clustering “bears any relationship to the procedures for dealing with the problem  
6 in a regression,”<sup>61</sup> the application of clustering to regression analysis is discussed in *Mostly*  
7 *Harmless Econometrics*, an econometrics book cited by Professor Noll, as well as many other  
8 sources.<sup>62</sup> Indeed, it is well recognized that, when the assumption of independent observations is  
9 not met, “[s]tatistical inference must control for clustering, as failure to do so can lead to  
10 massively underestimated standard errors and consequent over-rejection using standard

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13 identical, across observations. If the regression errors are the same, then the standard errors  
14 estimated by conventional methods (such as those employed by Professor Noll) will result in a  
15 severe overestimation of precision. This occurs when observations are essentially duplicated,  
16 creating the impression that there is far more information about the underlying relationships than  
17 actually exists; “[m]aking a data set larger by copying a smaller one *n* times generates no new  
18 information.” *Mostly Harmless Econometrics* at 310.

19 <sup>60</sup> Second Supplemental Noll Declaration at fn. 1. (“The use of the term independent refers to a  
20 standard assumption about the error term, which is that errors are independent draws from the  
21 same distribution function.”).

22 <sup>61</sup> Second Supplemental Noll Declaration at 18.

23 <sup>62</sup> *Mostly Harmless Econometrics* at 308-11. By ignoring intra-group (or intraclass) correlation in  
24 regression analysis “[e]ven small interclass correlations” can lead to substantial overestimation of  
25 precision (pp. 310-11). This is not a new problem. In 1986, Moulton showed that the standard  
26 errors based on the assumption that regression errors are uncorrelated will be smaller if regression  
27 errors are correlated within groups. See Moulton, Brent R., “Random group Effects and the  
28 Precision of Regression Estimates,” *Journal of Econometrics* 32 (1986) 385-397. An often cited  
technical article discussing these issues as well as the clustering procedure is “How Much Should  
We Trust Differences-In-Differences Estimates,” Marianne Bertrand, Esther Duflo, and Sendhil  
Mullainathan, *Quarterly Journal of Economics*, February 2004. See also *Proving Antitrust*  
*Damages- Legal and Economic Issues*, ABA Publishing, Second Edition, 2010 at pp. 145-146  
 (“There can be substantial consequences from estimating the standard errors for the coefficient  
estimates [in a regression] as if the errors were uncorrelated when they are in fact correlated.  
With positive correlation between the error terms, 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.”).

1 hypothesis tests.”<sup>63</sup> In my prior report, I demonstrated this problem and its effect by applying  
2 clustering analysis to Professor Noll’s reseller regression, which properly addresses the statistical  
3 problems created by having clusters of observations that may share unobserved correlation in  
4 their error terms. When clustering is applied to the reseller regression, the standard errors are  
5 substantially higher than those reported by Professor Noll. For example, Professor Noll reports a  
6 standard error on the iTunes 7.0 variable of 0.03, while the standard error after correction for  
7 clustering is 8.71.<sup>64</sup> This adjusted standard error indicates that the coefficient associated with the  
8 variable has no statistical significance and therefore, the coefficient can be considered to be zero  
9 for all practical purposes. That is, there is no statistically significant effect of iTunes 7.0 on iPod  
10 prices. This result is not limited to the iTunes 7.0 variable in the model, but extends to numerous  
11 other variables.

12 46. Professor Noll rejects my attempt to address the problem but conducts no test to  
13 check the intra-group correlation and makes no attempt to solve the problem in any other way.<sup>65</sup>  
14 Professor Noll claims that “[t]he necessary condition for a correction for clustering to be useful is  
15 that strictly ‘within-cluster correlation’ is ‘substantial, which means the usual OLS standard errors  
16 can be very misleading.”<sup>66</sup> He thus implies that no substantial within-cluster correlation exists

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18 <sup>63</sup> Colin Cameron and Douglas L. Miller, “Robust Inference with Clustered Data,” in *Handbook*  
19 *of Empirical Economics and Finance*, edited by Aman Ullah and David E. A. Giles, CRC Press  
20 2011, pp. 1-28 at p. 2.

21 <sup>64</sup> See Burtis Supplemental Report, Exh. A.

22 <sup>65</sup> Professor Noll claims that the problem is not clustering but omitted variables. He claims that  
23 “[o]mitted variables create a problem only if they are correlated with an independent variable that  
24 is included in the regression.” Second Supplemental Noll Declaration at p. 21. This is incorrect  
25 (though I discussed how Professor Noll’s regressions suffer from such “omitted variable bias”  
26 earlier in my report). Regardless of whether such omitted variable bias exists, an omitted variable  
27 can also “create a problem” if it is correlated across observations. This is the problem of  
28 clustering. This is discussed in *Proving Antitrust Damages- Legal and Economic Issues*, ABA  
Publishing, Second Edition, 2010 at p. 145 (“Unobserved economic factors [omitted variables]  
may affect all customers’ prices at a given point in time and therefore these common factors will  
appear in the errors of all the customers in a given time period. Similarly if these unobserved  
factors are themselves serially correlated, then the error for one customer in one month will be  
correlated with the error for another customer in another month.”).

<sup>66</sup> Second Supplemental Noll Declaration at 23. Professor Noll is misinterpreting the meaning of  
(continued)

1 here. But it is a simple matter to calculate such “within-group” (or intraclass) correlation—and  
2 that test demonstrates that it exists here.<sup>67</sup> The intraclass correlation for cluster groups defined as  
3 model (e.g., 1<sup>st</sup> generation iPod classic 20GB) and quarter is equal to 0.998. This level of  
4 intraclass correlation is much higher than what is considered problematic. In the text cited by  
5 Professor Noll, intraclass correlation of 0.1 is found to result in large differences between the  
6 actual and the estimated regression errors.<sup>68</sup> Without some solution or adjustment, the standard  
7 errors of his regressions are not valid and lead to the erroneous conclusion that the results are  
8 “precise,” when they are not precise at all.<sup>69</sup>

9 47. In the retail regression, Professor Noll has only 385 observations. However,  
10 through the use of a particular estimation procedure, Professor Noll duplicates each price

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12 the sentence by selectively quoting from the source. According to the source, in the presence of  
13 the common group effects in the regression error term, “the within-cluster correlation can be  
14 substantial, which means the usual OLS standard errors can be very misleading.”

15 <sup>67</sup> Intraclass correlation describes how strongly observations within a group are correlated with  
16 each other.

17 <sup>68</sup> See *Mostly Harmless Econometrics* at 311.

18 <sup>69</sup> Professor Noll claims that the reseller sample does not suffer from the problem of random  
19 group effect or clustering because “clustering is a problem of small samples” and “[t]he number  
20 of clusters identified by Dr. Burtis is in the hundreds, which is far more than the number that  
21 econometricians normally would regard as creating a potential problem.” Second Supplemental  
22 Noll Declaration, p. 23. However, the problem of random group effects or clustering is not a  
23 small sample problem. The intra-group correlation will not vanish if the number of observations  
24 increases. Professor Noll seems to suggest that if there are more than 42 clusters, the problem of  
25 understated standard error due to group random effects is eliminated. In support, Professor Noll  
26 cites the econometrics book *Mostly Harmless Econometrics* to make the point that “[t]he number  
27 of clusters identified ... is far more than the number that econometricians normally would regard  
28 as creating a potential problem.” Second Supplemental Noll Declaration at p. 23. However, this  
claim is wrong and a misinterpretation of the text. The text addresses how many clusters are  
enough for reliably applying solutions such as clustered standard errors, which I used in Exhibit  
A to my July 2011 Report. The answer to that question is that, if the number of clusters is high  
enough (e.g., 42 is a guideline lower bound), then a solution such as clustered standard errors can  
be used. If not, then one would need to use more complicated approaches to solve the problem.  
*Mostly Harmless Econometrics* at 319-323. Either way, the problem exists and must be  
corrected—not ignored. Further, Professor Noll claims that “the condition for clustering to be a  
problem—unobserved common effects—is not present” because of indicators in his regressions.  
Second Supplemental Noll Declaration at 25. Professor Noll provides no academic support for  
this conclusion, which is incorrect. Including cluster specific indicator variables does not solve  
the problem of clustering.

1 transaction according to the quantity of iPods bought in that transaction and thus, produces  
2 standard errors that are incorrect.<sup>70</sup> Through the use of this particular estimation technique, the  
3 regression essentially duplicates the observations to yield 44,777,096 observations.<sup>71</sup> This  
4 duplication creates the same problem as the problem described above with respect to the reseller  
5 regression.<sup>72</sup> Calculated standard errors for the regression coefficients appear to be low and  
6 statistical significance appears to be high, when in fact this is not the case. When this duplication  
7 is undone, the results are markedly different. For example, undoing this procedure causes the  
8 statistical significance of the iTunes 7.0 update dummy variable to fall dramatically. The  
9 standard error reported by Professor Noll is 0.03. Undoing the duplication yields a standard error  
10 of 11.17. Professor Noll reports that the iTunes 7.0 coefficient is statistically significant at the 1  
11 percent level. Undoing the duplication implies that the iTunes 7.0 coefficient is only statistically  
12 significant at the 67 percent level, or highly insignificant. Professor Noll has acknowledged, in  
13 earlier testimony, that the lack of retail price variability could render this type of model unreliable  
14 and thus he was considering other methods for calculating damages to retail proposed class  
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18 <sup>70</sup> Professor Noll uses a “FREQ” statement in his regression with quantity sold in a transaction as  
19 the weight. When a FREQ statement appears, each observation in the input data set is assumed to  
20 represent n observations, where n is the value of the FREQ variable. The analysis produced when  
21 you use a FREQ statement is the same as an analysis produced by using a data set that contains n  
22 observations in place of each observation in the input data set. When the procedure determines  
23 degrees of freedom for significance tests, the total number of observations is considered to be  
24 equal to the sum of the values of the FREQ variable. See SAS/STAT® 9.2 User’s Guide,  
25 Chapter 73: The Reg Procedure, p. 5462. Available at  
26 <http://support.sas.com/documentation/cdl/en/statugreg/61824/PDF/default/statugreg.pdf>

27 <sup>71</sup> Professor Noll did not explain the rationale for this technique in his report.

28 <sup>72</sup>



1 members.<sup>73</sup> It is only through this technique that the regression method returns what appear to be  
2 statistically significant results.

3 48. The retail regression produced by Professor Noll is based not on the actual prices  
4 of iPods paid by retail consumers, but instead on quarterly average prices. Professor Noll has  
5 acknowledged that consumers who purchase iPods directly from Apple pay Apple's list prices,  
6 yet he does not use those list prices in his retail regression. The average quarterly prices do not  
7 accurately represent the actual prices paid by retail customers. In certain time periods, the use of  
8 the average quarterly prices does not capture actual price reductions. For example, at the time of  
9 the iTunes 7.0 introduction, Apple reduced certain iPod prices. Professor Noll's data do not  
10 capture this reduction. This is shown in Exhibit 8 for the iPod Classic, fifth generation, 60 GB.  
11 A dummy variable for iTunes 7.0, like the one that Professor Noll uses in this regression, will  
12 produce a result that is biased upward (*e.g.* it is too high or too positive) because it is not  
13 capturing actual price reductions that occurred at the same time the dummy variable is "turned  
14 on." This is an additional reason that Professor Noll's results cannot be relied on to claim any  
15 overcharge on iPod prices due to the alleged conduct.

16 **The Underlying Statistical and Specification Problems Lead To A Model That is Not Robust**

17 49. Professor Noll's proposed model is not robust. A robust model will not produce  
18 substantively different results when slight changes are made to the specification. In this case, the  
19 addition of variables consistent with Professor Noll's purported theory leads to substantially  
20 different and in certain cases, opposite, findings, which evidences that the proposed model is not  
21 reliable. For example, adding a dummy variable for the iTunes 8.0 update to Professor Noll's  
22 reseller regression make the 7.0 variable negative.<sup>74</sup> Similarly, accounting for the re-launch of  
23 Harmony in April 2005 produces very different results and shows, for example, that the

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25 <sup>73</sup> Noll April 2011 Deposition Tr. at 45:17-48:3.

26 <sup>74</sup> Exhibit 9 shows that the coefficient on the iTunes 7.0 dummy variable is -11.04. In addition,  
27 there are other examples of substantially different coefficients returned by this specification,  
28 compared to the one produced by Professor Noll, including different capacity variables being  
positive in one specification and negative in the other and the effect of competitors offering  
DRM-free music being positive in one specification and negative in the other.

1 coefficient on the dummy variable associated with the iTunes 7.0 update is negative, not  
2 positive.<sup>75</sup> See Exhibit 10.<sup>76</sup>

3 **Professor Noll Does Not Claim That Plaintiffs' Other Theories of Impact Can Be Proved on**  
4 **a Common Basis**

5 50. Professor Noll's regression models are limited to attempting to show only the  
6 existence of an overcharge in iPod prices. He does not attempt to show that he has an allegedly  
7 common method for proving impact on Plaintiffs or other class members from the other theories  
8 of harm he has previously asserted, including that (1) lower sales of iPods, due to higher prices,  
9 causes "dead-weight loss"; (2) the prices of other firms in the market may be higher; (3) the  
10 alleged "lock-in" increased switching costs and reduced consumers' product choices; and (4) the  
11 alleged "lock-in" could have slowed technological progress.<sup>77</sup>

12 51. Each of these theories of harm would require individualized analysis of impact,  
13 and/or is not impact felt by the putative class. Dead-weight loss, or the "loss of welfare arising  
14 from the reduction in output"<sup>78</sup> to the extent it is present, is a loss felt by consumers who did not  
15 actually make iPod purchasers; thus it is not a loss felt by the putative class, who all purchased  
16 iPods. Similarly, Professor Noll claims that the prices of other firms in the market may be higher.  
17 Again, these are prices of products not purchased by the putative class, or at least no claim is  
18 made for those purchases here. And any such claim would in any event present individual issues  
19 regarding what particular purchase was made and at what price. Similarly, determination of  
20 impact due to fewer choices or different choices, due to slower technological change, requires

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21  
22 <sup>75</sup> Professor Noll was asked what he would conclude if, when a dummy variable for the relaunch  
23 of Harmony in early 2005 was added the iTunes 7.0 variable became negative or insignificant, he  
24 testified that "then either there is no damages or there's something structurally wrong with the  
25 model." Noll November 2011 Dep. Tr. at 67-68.

26 <sup>76</sup> Exhibit 10 shows that when the iTunes 4.7 dummy variable is reset to 0 when Harmony re-  
27 launched (consistent with Professor Noll's view that "any indicator variable should be "on" only  
28 if the associated prices could plausibly be affected by it" (Second Supplemental Noll Declaration,  
p. 9)) the coefficient on the iTunes 7.0 dummy variable is -2.43.

<sup>77</sup> Declaration of Roger G. Noll, filed Jan. 18, 2011, at 23-24, 64-65.

<sup>78</sup> Noll Decl. at 64.

1 information about individual consumers' preferences. This can only be obtained via  
2 individualized inquiry. Consumers do not always want the latest electronic device or prefer the  
3 latest technological feature or characteristic.

4 I declare under penalty of perjury that the foregoing is true to the best of my knowledge  
5 and belief. Executed on November 14, 2011 in Washington, D.C.

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Michelle M. Burtis, Ph.D.

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