EXHIBIT B

UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF CALIFORNIA
SAN FRANCISCO DIVISION

ORACLE AMERICA, INC.,)
Plaintiff,)
vs.) No. CV 10-03561 WHA
GOOGLE, INC.,)
Defendant.)
______________________________)

-- ATTORNEYS' EYES ONLY --

Videotaped deposition of ADITYA KUMAR AGARWAL, taken at the law offices of King & Spalding LLP, 333 Twin Dolphin Drive, Redwood Shores, California, commencing at 9:31 a.m., Friday, April 8, 2011, before Leslie Rockwood, RPR, CSR No. 3462.

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he had with counsel, he can answer it.

MS. RUTHERFORD: Okay. All right.

Q. What is your response to the question?

A. I'm agreeing with Bruce.

Q. You don't understand what a 30(b)(6) witness is? 09:37:20

A. Not more than what Bruce has --

Q. You don't understand that you represent the corporation as a whole?

A. I'll only discuss those things which are not discussed with our counsel team. 09:37:29

Q. Are you prepared here today to speak to the topics before us, which is Google's revenues related to Android, including the identity of each person with knowledge regarding such revenues? 09:37:49

A. Yes, to the best of my understanding.

Q. Are you also prepared to speak to how Google accounts for Android-related revenues and expenses?

A. Uh-huh. Yes.

Q. Are you also prepared to speak to all profits, losses, revenues, expenses and costs associated with Android, including those associated with Android market and advertising on Android-related enabled devices? 09:38:01

A. Yes. 09:38:13

Q. Uh-huh.

A. I don't do engineering productivity, the third bullet point anymore. I don't do the fourth bullet point, employ costs analysis, anymore.

Q. Who does those things that you no longer do? 09:47:05

A. Other members of product and engineering finance.

Q. And do you have additional responsibilities now that you've ceded those responsibilities to other members? 09:47:18

A. I'm only focusing all my time and energy on Android.

Q. Okay. Thank you.

MS. RUTHERFORD: I'm going to mark an article from the Motley Fool, entitled "Does Google Have an 09:47:26 Android Revenue Model," as Exhibit 13.

(Exhibit 13 marked.)

Q. BY MS. RUTHERFORD: Now, if you look in the third full paragraph, it says, "Google CEO Eric Schmidt was questioned with regard to Android's -- whether there 09:47:55 was a way to measure Android's success. And he said, 'Trust me. We do.' When asked if the revenue was enough to support an Android project, Schmidt pointed out Google's ad review revenue model, saying, 'Trust me. The revenue is large enough to pay for all of the Android 09:48:14

activities and a whole bunch more.'"

Do you see that?

A. Yes.

Q. Do you know what the basis for that statement is? 09:48:23

A. All -- the basis is Google's ad revenues on Android devices.

Q. Could you explain how Google's ad revenues on Android devices is large enough to pay for all of Android's activities? 09:48:37

[redacted] 09:48:59

Q. Mr. Schmidt indicates that it pays for the cost of Android's activities and, quote, "a whole bunch more." Is that your understanding?

MR. BABER: Object to the form.

THE WITNESS: I don't understand what is "a whole bunch more." 09:49:24

Q. BY MS. RUTHERFORD: Do you understand whether the Google ad revenues on Android devices is sufficient enough to cover both the cost of Androids and have enough money left over to pay for other things or exceed the 09:49:41

costs?

A. I can only speak about Android.

Q. That's what I'm asking you about. Do you understand that Google's ad revenue on Android devices is sufficient to both cover the costs of Android related activities and more? 09:49:55

A. I don't know what "more" is.

Q. Does the revenue received from Google's ad revenue on Android devices exceed the costs?

A. Costs for Android? 09:50:19

Q. That is correct.

A. It covers for -- costs for Android.

Q. You still have not answered the question. Let's try this again.

Per your former CEO as of -- until last week, 09:50:35 your CEO Eric Schmidt said that Google's ad revenue, it was large enough to pay for all Android activities and a whole bunch more.

So my question to you was whether Google's ad revenue on Android devices exceeded its costs. And your 09:50:56 answer is "yes" or "no"?

A. Google's ad revenues on Android cover for a portion of Android's costs.

Q. So it does not exceed its costs? Is that your answer? 09:51:13

A. When you say "costs," what exactly do you mean? What exactly do you mean?
Q. Why don't you define costs for me -- your understanding of costs.
A. My understanding of costs is any cost related 09:51:24 to serving off those ads on Android devices. And yes, we do cover for those costs.
Q. All right. Thank you.
Let's talk about how Google makes its revenue on Android. This article lists a number of potential 09:51:53 revenue sources. I'd like you to identify for me --
A. Can I take some time to read this article?
Q. Well, the questions are not really based on the article. They're more abstract. So if you can just listen to my questions. 09:52:07
A. Okay. So then this is not related to the article?
Q. Just listen to the questions, please.
MR. BABER: No. I object. If the witness wants to read the article, I believe he has a right to 09:52:13 read the article.
MS. RUTHERFORD: Well, the question is not about to the article. So let me ask the question.
MR. BABER: The witness is still allowed to read the document you put in front of him, if he desires 09:52:23

its profits on other mobile devices?

A. I don't know.

Q. Now, when you say you don't recall, are you saying you don't remember or you don't know?

A. I don't recall if I have done it or any other person has done it. 10:14:36

Q. What documents or databases would I need to look at to identify total revenues for Android?

[redacted]

10:15:36

[redacted] 10:16:20

Q. Well, let's mark as Exhibit 16 -- okay. Hold on a second.

MS. RUTHERFORD: I can't tell if -- these are just loose copies. I can't tell where one ends and one begins. 10:16:47

Q. While he's doing that, P&L stands for profit and loss; correct?

A. Yes.

Q. Could you also explain what DTC stands for?

A. Direct to consumer. 10:17:04

Q. Other than Nexus One, did you have any direct to consumer products?

A. No.

[redacted]

(Exhibit 16 marked.)

Q. BY MS. RUTHERFORD: Now that you have this document in front of you, do you recall what a P&L archive is? 10:18:02

Q. Who is on the central team?

A. We usually work with a person named Danielle Romain.

Q. Could you spell the last name for the court reporter, please? 10:33:59

A. R-o-m-a-i-n.

Q. And you said that the central team that includes Mr. Romain --

A. Sorry. Correction, Ms. Romain.

Q. Oh, Miss Romain. Sorry. 10:34:11

[redacted] 10:34:59

[redacted]

Q. What growth rate do you use when you're 10:36:35

Ms. Danielle Romain.

Q. Ms. Danielle Romain. Sorry.

A. And that is the data in this form that we get.

Q. So these inputs come from Danielle Romain? 11:17:42

A. That's right.

Q. And you do not know where she obtains that data from?

A. No.

[redacted] 11:18:36

[redacted]

Q. If we turn to page 3 of the document, where it says -- the first line is "Revenue Ads."

A. Uh-huh. 11:19:39

Q. DIST, is that distribution?

A. That's right.

Q. And it says, "Plus Organic"?

A. Yes.

Q. Could you explain what "organic" means in 11:19:47

Q. Would you agree with the statement that no revenue is generated by Android?

A. Android OS is Open Source. It's free. Yes, no revenue is generated from Android.

[redacted]

MS. RUTHERFORD: Okay. I think we're done.

THE WITNESS: Okay.

MR. BABER: We have no questions.

THE VIDEOGRAPHER: This is the end of the 12:37:28

REPORTER'S CERTIFICATE

I certify that the proceedings in the within-titled cause were taken at the time and place herein named; that the proceedings were reported by me, a duly Certified Shorthand Reporter of the State of California authorized to administer oaths and affirmations, and said proceedings were thereafter transcribed into typewriting.

I further certify that I am not of counsel or Attorney for either or any of the parties to said Proceedings, not in any way interested in the outcome of the cause named in said proceedings.

IN WITNESS WHEREOF, I have hereunto set my hand: April 12, 2011

Leslie Rockwood

LESLIE ROCKWOOD, CSR. NO. 3462
Certified Shorthand Reporter
State of California

EXHIBIT D

UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF CALIFORNIA
SAN FRANCISCO DIVISION

ORACLE AMERICA, INC.,)
Plaintiff,)
vs.) No. CV 10-03561 WHA
GOOGLE, INC.,)
Defendant.)
_______________________________)

-- HIGHLY CONFIDENTIAL, ATTORNEYS' EYES ONLY--

Videotaped deposition of ALAN J. COX, PH.D., taken at the law offices of Keker & Van Nest LLP, 633 Battery Street, San Francisco, California, commencing at 9:24 a.m., on Wednesday, October 26, 2011, before Leslie Rockwood, RPR, CSR No. 3462.

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Q. Do you recall who that was?

A. No.

Q. How long did the conversation last?

A. It was about 15, 20 minutes at the most.

Q. And based on your conversation with Mr. Agarwal, are you relying on your conversation with Mr. Agarwal on October 24th in support of any of the opinions that you expect to offer in this case? 10:22:11

MR. KWUN: Objection. Form.

THE WITNESS: Well, it just provides confirmation of -- contamination of what it I was -- let me put it better. 10:22:32

It provides further confirmation that I what did in terms of deducting costs from revenues and calculating the wrongful profits was appropriate. 10:22:49

Q. BY MR. NORTON: And you had, in your background explanation of what Exhibit 669 was, you said that you had done an allocation of expenses based on your prior conversations with Mr. Agarwal, the pertinent deposition testimony, and your review of the Android P&L. 10:23:07

Is that right?

MR. KWUN: Objection. Form.

THE WITNESS: Let me correct one part of the premise. I didn't do an allocation. I just took the expenditures that Google had booked on its P&Ls for 10:23:17

Android, having determined based on the sources that you cited that it was appropriate to do so.

Q. All right. So you reached an opinion prior to October 3rd that the allocation of expenses on the Android P&L was appropriate? 10:23:41

THE WITNESS: Objection. Form.

THE WITNESS: You keep using the word "allocation," and let me just say as a blanket statement that there was no allocation involved, as far as I could tell. That these were just bookings of expenditures made 10:23:56 on the Android platform.

Q. BY MR. NORTON: And to reach that conclusion, you looked at the Android P&L, the pertinent depositions, and you had a conversation or conversations with Mr. Agarwal? 10:24:11

A. That's correct.

Q. All right. And when you say "pertinent depositions," which depositions are you referring to?

A. Well, his certainly.

Q. Anyone -- anyone other than Mr. Agarwal? 10:24:20

A. Not -- none that I can recall as I sit here.

MR. NORTON: I think it might be expeditious to take a short break because I'm going to mark a bunch of exhibits, and I won't make you sit here and watch me.

THE WITNESS: Okay. 10:24:46

Mr. Schmidt or anything, but I was retained, as I describe in my report, to calculate damages in this matter as an economist, and I believe I have done that. And I can rely on my own professional training and the methodologies of the discipline to do that. 11:06:44

Q. All right. And one of the things that you have to do in order to calculate wrongful profits is to determine what expenses are attributable to Android; correct?

A. That's correct. 11:06:56

Q. All right. And in order to determine what expenses are attributable to Android, you reviewed the Android P&L; right?

A. Yes.

Q. You spoke to Mr. Agarwal? 11:07:05

A. Yes.

Q. And you reviewed Mr. Agarwal's deposition transcript?

A. That's correct.

Q. All right. And it's -- using the standards in your discipline, you believe that that is a sufficient basis for you to determine what the appropriate costs are for Android? 11:07:12

A. Yes.

Q. All right. Now, you have -- in your stack 11:07:27

there of exhibits, one of them is Exhibit 278 -- I'm sorry. 678. I'm 400 behind.

MR. KWUN: I don't have a copy of that document.

MS. DEARBORN: (Indicating.) 11:07:45

Q. BY MR. NORTON: And you also have 679.

A. Yes.

Q. All right. Let me draw you to 679 first.

A. Okay.

Q. I think 679 is the -- yeah. There we go. 11:07:54

MR. KWUN: Which one is 679?

MR. NORTON: 679 should be the --

THE WITNESS: (Indicating.)

MR. KWUN: Okay.

Q. BY MR. NORTON: So have you ever seen -- do 11:08:04
you recognize Exhibit 679 at all?

A. Yes.

Q. All right. And what do you recognize it to be?

A. The deposition of Mr. Agarwal. 11:08:12

Q. All right. And did you read that before you submitted your report?

A. I certainly read parts of it, yes.

Q. All right. Do you know whether you read the parts that I've handed to you? 11:08:23

A. I don't -- I don't recall without reading it.

Q. How did you decide which parts of

[redacted]

11:10:48

[redacted] 11:11:48

[redacted] 11:12:41

[redacted] 11:13:40

[redacted]

Q. BY MR. NORTON: And so the only person at Google that you spoke to to determine whether or not the allocation on the P&L was an appropriate one, that is the manner in which the expenses were booked was an appropriate one, was Mr. Agarwal; correct? 11:14:28

A. Yes. I spoke with Mr. Agarwal. I think the first time I spoke with Mr. Agarwal there was somebody 11:14:48

else in the room, but, basically, the discussion was through Mr. Agarwal.

Q. All right. And in your report the only person you cite in support of the allocation of expenses is Mr. Agarwal; right? 11:15:00

A. That's -- that's correct, yes.

Q. All right. And when I asked you in your deposition testimony here today the bases for your conclusion that the allocation was appropriate, the only person that you've ever mentioned is Mr. Agarwal; 11:15:14 correct?

MR. KWUN: Objection. Form.

THE WITNESS: That's correct. Though, as I said in reference to these notes that we talked about earlier, I did do an additional test that determined to 11:15:23 my satisfaction that my original conclusion after those discussions was correct.

Q. BY MR. NORTON: And your test was to go back and to ask Mr. Agarwal again?

A. Well, I went back and asked Mr. Agarwal 11:15:35 again, and he provided me with specific numbers that explained a change in expenditures on engineering.

Q. Now, you also have Exhibit 678 in front of you; right? Should be the handwritten notes.

MR. COOPER: Are the handwritten notes 678 or 11:16:02

679?

MR. NORTON: I apologize. 679.

MR. KWUN: 679 I was told was the transcript -- the Agarwal transcript.

THE WITNESS: That is correct. 11:16:13

MR. NORTON: All right. I'll do that again before the day is out. 679 is the transcript. 678, the witness actually knows best, but should have the sticker that says 678.

THE WITNESS: 678 are the handwritten notes. 11:16:25

Q. BY MR. NORTON: Okay. Thank you.

And those are your notes?

A. Yes.

Q. And these are notes of your conversations with Google employees? 11:16:39

A. Yes.

Q. Are these all of your notes of your conversations with Google employees?

A. They're all the ones that I could find, yes. And there were other interviews where I didn't take 11:16:55 notes.

Q. How many times did you interview -- before October 3rd did you interview Mr. Agarwal?

A. At least once. I'm trying to think if there was a second occasion. It may have been twice. 11:17:26

Q. And in Exhibit 678, are there any notes of any of your conversations with Mr. Agarwal?
A. I don't believe so, no.
Q. Were your interviews with Mr. Agarwal prior to October 3rd in person or by telephone? 11:17:46
A. By telephone.
Q. Did any members of your staff participate -- NERA staff participate in that phone call or phone calls?
A. Yes. They did.
Q. Did they take notes? 11:18:03
A. They may have.
Q. Did you direct them to?
A. No.
Q. Did you direct them not to?
A. No. 11:18:09
Q. Do you know whether any members of your staff have a practice of keeping notes?
A. Generally, they don't.
Q. Do you know was there a particular person on your staff who participated in your conversations with Mr. Agarwal? 11:18:20
A. No.
Q. All right. So the three things that you relied on to determine whether the allocation or booking of expenses for Android was appropriate were your 11:18:45

interviews with Mr. Agarwal -- or interview, his deposition testimony and the P&L itself?

MR. KWUN: Objection. Form.

THE WITNESS: Well, I also had some discussion with counsel. But I didn't rely on that. 11:19:08

Q. BY MR. NORTON: So the only -- let me ask it a little differently, then.

The only bases you're relying upon to reach your opinion that the allocation of expenses that appears on the Android P&L is an appropriate one, those bases 11:19:20 that you're relying on are Mr. Agarwal's deposition testimony, your conversation or conversations with Mr. Agarwal before October 3rd, the P&L itself?

MR. KWUN: Objection. Form.

THE WITNESS: That's -- that's -- so far, 11:19:34 that's correct. I mean, before October 3rd, that's correct.

Q. BY MR. NORTON: And then on October 24th, you went back to Mr. Agarwal and asked some additional questions to test? 11:19:48

MR. KWUN: Objection. Form.

THE WITNESS: That's correct.

Q. BY MR. NORTON: Okay. Did you ever ask to speak to someone other than Mr. Agarwal in order to determine the accuracy or correctness of the allocation 11:20:03

of expenses on the Android P&L?
A. No.
Q. Now, the Android P&L that you reviewed, where did you get it?
A. I don't recall how we got it. I just asked my staff to make sure we got it. And when we got it, they pointed me to where it was. 11:20:26
Q. If you would look at your report -- and again, let's use the most recent version of it.
A. Okay. 11:20:59
Q. That's Exhibit 672.
A. Okay.
Q. And if you would turn to your exhibit --
MR. KWUN: Fred, I don't think 672 has the exhibits. That's the redline. 11:21:21
MR. NORTON: Oh, is it the redline? I apologize. 671. Thank you, Michael.
THE WITNESS: So we're looking at 671?
Q. BY MR. NORTON: Yes, which has your exhibits. Exhibit 3B. 11:21:43
A. Okay. Okay. Got it.
Q. All right. And that's the profit and loss statements of the Android platform?
A. Yes.
Q. And Item 1 -- or Note 1 under your "Notes and 11:21:55

Sources," says, "Android P&L through August 20.xls, received from counsel September 29, 2011."
A. Yes.
Q. All right. So is that correct, you got the P&L from counsel? 11:22:11
A. That's correct. We did have an earlier version of this, of the P&L. But the version we used for finishing the full report was based on the transmission that is reported in footnote 1.
Q. And are you relying on the earlier version 11:22:33 that you had, or are you relying upon the one that's cited in Exhibit 3B?
A. The one that's cited in 3B.
Q. Okay. And that's the one that you got from counsel? 11:22:44
A. Well, I presume we got the other one from counsel, too. But yes, we did get that one from counsel.
Q. All right. And the Android P&L through August 20.xls, that document, is that an audited financial statement? 11:22:56
A. No. It's based -- as I understand it, it's a printout of their own internal reporting system -- of Android's internal reporting system.
Q. Now, it has historical data going back a few years; right? 11:23:08

A. Yes.

Q. And are any of the numbers audited numbers?

A. No. Well, I'll say not that I know of.

Q. Did you look at any other financial documents to -- other than the P&L itself, did you look at any other Google financial documents to verify the accuracy of the booking of expenses on the Android P&L? 11:23:41

MR. KWUN: Objection. Form.

THE WITNESS: I had it in my mind that I did see something else, but I can't remember what it was. So basically, the P&Ls are all that I can actually visualize or remember looking at. 11:24:34

I will say that P&Ls are the sorts of things -- that I saw, were the sorts of things that were consistent with what I've seen in other companies for their internal reporting of their operations. 11:24:48

Q. BY MR. NORTON: Did you look at P&Ls for any -- P&Ls for any of Google's other lines of business to see if the P&L you were looking at was consistent with the way Google books expenses in other parts of its business? 11:25:06

A. No. I don't think I did.

Q. Did anybody tell you you could not do that, if you wanted to?

A. No. 11:25:17

Q. In your report at page 30 --
A. Yes.
Q. -- where you discuss your five-year -- your decision to use a five-year period; right?
A. Yes. 13:17:58
Q. And you cite the Bureau of Economic Analysis in Footnote 111; right?
A. Yes.
Q. And then the FASB standard that you cite actually doesn't say anything about five years. It talks 13:18:10 about whether it's a straight line or ratio of current year revenue divided by future expected revenue.
A. Yes. Yes.
Q. So if you're talking about five years, you're relying on the citation of the Bureau of Economic 13:18:23 Analysis; right?
A. And my own introspection on the issue.
Q. All right. And you're not an accountant; right?
A. Well, this is not an accounting issue. But 13:18:31 no, I'm not.
Q. Well, FASB is an accounting standard; right?
A. Yes.
Q. Okay. The -- when you say that a five-year amortization period is consistent with prevailing 13:18:52

STATE OF CALIFORNIA) ss:
COUNTY OF MARIN)

I, LESLIE ROCKWOOD, CSR No. 3462, do hereby certify:

That the foregoing deposition testimony was taken before me at the time and place therein set forth and at which time the witness was administered the oath;

That testimony of the witness and all objections made by counsel at the time of the examination were recorded stenographically by me, and were thereafter transcribed under my direction and supervision, and that the foregoing pages contain a full, true and accurate record of all proceedings and testimony to the best of my skill and ability.

I further certify that I am neither counsel for any party to said action, nor am I related to any party to said action, nor am I in any way interested in the outcome thereof.

IN WITNESS WHEREOF, I have subscribed my name this 27th day of October, 2011.

Leslie Rockwood

LESLIE ROCKWOOD, CSR. NO. 3462

EXHIBIT E

IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF CALIFORNIA
SAN FRANCISCO DIVISION

ORACLE AMERICA, INC.	)	
Plaintiff,	)	
v.	)	Case No. 3:10-CV-03561-WHA
GOOGLE, INC.	)	
Defendant.	)	

EXPERT REPORT OF
PROFESSOR JAMES R. KEARL

March 21, 2012

Table of Contents

I. Qualifications

1. I am currently the A.O. Smoot Professor of Economics at Brigham Young University (BYU) and a Senior Consultant with Charles River Associates, a firm that provides expert analysis, litigation support, and business consulting in sophisticated matters involving economics and finance. I received my Ph.D. in Economics from the Massachusetts Institute of Technology in 1975 and completed postdoctoral studies in law and economics at the Harvard Law School in 1979. I have been a member of the Economics Department at BYU since 1975. Prior to that time I was a teaching fellow at Harvard University. From 1978 to 1983, I held a joint appointment in the Economics Department and J. Reuben Clark Law School at BYU. Over the past 30 years, I have taught courses in the Principles of Economics, Microeconomic Theory, Applied Microeconomics, Industrial Organization, Economics of Antitrust and Regulation, Applied Welfare Economics, International Trade, International Trade Policy, and Law and Economics. I have also team taught courses at BYU's J. Reuben Clark Law School in Antitrust Law, Regulatory and Administrative Law, and International Trade Law and Regulation. In addition, I have lectured for the U.S. Government in a number of countries on the Economics of U.S. Trade Policy, Law and Economics, and the Economics of U.S. Antitrust Laws. I have also taught courses on the same topics at the Republic of China's Professional Training Center and at its Land Development Institute. My curriculum vita is attached to this report as Appendix A. A list of testimony provided during the past four years is attached to this report as Appendix B. My hourly billing rate for this assignment is $565 hour.

II. Assignment

2. I have been retained by the Court, per Judge William Alsup's order of September 9, 2011 to a) independently critique the damages reports submitted by each party, b) provide my assessment of any or all issues raised or presented in the damages reports of the par-

ties, and c) address each additional issue I believe should be evaluated in order to provide the jury with a complete and independent view of damages in this case.[1] In carrying out my assignment, I have reviewed and evaluated the analyses and reports of Profs. Iain M. Cockburn and Stephen M. Shugan, and Drs. Gregory K. Leonard and Alan J. Cox.

3. Prof. Cockburn estimates damages for both patent and copyright infringement.[2] His patent and copyright infringement damages analysis relies, in part, on work done by Prof. Shugan.[3] Dr. Leonard has critiqued Prof. Cockburn's patent infringement damages analysis, but he has also critiqued Professor Shugan's work upon which Prof. Cockburn relies in estimating copyright infringement damages.[4] Dr. Cox, relying in part on Dr. Leonard's critique of Prof. Shugan, has critiqued Prof. Cockburn's copyright infringement damages.[5]

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[1] Order Re Rule 706 Expert, dated September 9, 2011.

[2] Expert Report of Prof. Cockburn 5/20/2011;
Second Expert Report of Prof. Cockburn 9/12/2011, revised 9/15/2011;
Third Expert Report of Prof. Cockburn 2/3/2012, revised 2/8/2012;
Cockburn Reply Report to Dr. Leonard 10/10/2011;
Cockburn Reply Report to Dr. Cox 10/10/2011;
Cockburn Declaration ISO Oracle Motion to Strike Portions of Gregory Leonard Supp 2/24/2012;
Cockburn Declaration ISO Oracle Opposition to Google Motion to Strike 2/24/2012.

[3] Expert Report of Dr Shugan 9/12/2011;
Shugan Reply Report to Dr. Leonard 9/28/2011;
Shugan Declaration ISO Mtn to Exclude Portions of Cox & Leonard 10/21/11;
Shugan Declaration ISO reply ISO Mtn to Strike Leonard & Cox 11/1/2011;
Shugan Declaration ISO Opposition to Google Third Daubert Motion 2/24/2012

[4] Expert Report of Dr. Leonard 10/3/2011, revised 10/24/2011;
Supplemental Expert Report of Dr. Leonard 2/17/2012;
Leonard Declaration 6/14/2011;
Leonard Declaration ISO Google Opp to Mot to Exclude Portions of Cox & Leonard Report 10/28/2011;
Leonard Declaration ISO Google Opp to Mot to Exclude Leonard Supplemental 3/2/2012

[5] Expert Report of Dr. Cox 10/3/2011, revised 10/21/2011, revised 11/28/2011;
Supplemental Expert Report of Dr. Cox 2/17/2012

4. I assume for purposes of my analyses that Google has been found to have infringed one or more in-suit patents and/or the in-suit copyrights.

5. I have no expertise in the law, in the engineering and technical aspects of this intellectual property in this case, or in resolving factual disputes. As such, I have tried to be very careful with regard to differences between Profs. Cockburn and Shugan, and Drs. Leonard and Cox that may turn on technical or factual disputes where economic principles or analysis provide little or no insight and have tried, in so far as possible, to focus on those areas where economic analysis provides assistance to the Court.

III. Materials Relied Upon

6. Typically, an expert witness works closely with the counsel for the party who retained him. This is helpful because an expert can rely on the party's counsel to provide evidence, either supportive or not, from the record relevant to his opinions. Since I was retained by the Court and not Google or Oracle, my ability to access the voluminous record in this case is more limited. I have assumed that because of the adversarial nature of litigation, however, all of the material in this voluminous record directly relevant to damages is contained in the experts' original, rebuttal and reply reports, revisions of reports, deposition testimony and deposition exhibits. Hence, the universe of discovery materials with which I've worked is the documents, deposition testimony and evidence cited in the technical and damages expert reports filed in this matter, backup materials for the analyses incorporated in these reports including data collected by the experts, exhibits introduced at the depositions of experts, and the deposition testimony of the experts. I have also had the unusual privilege of holding off-the-record discussions with the parties' damages and technical experts.

7. I have also relied on data, computer code and Excel worksheets provided by Prof. Cockburn and computer code provided by Dr. Leonard to implement and test their regression

and follow-on analyses. Likewise, I have relied on data provided by Prof. Shugan, and the Sawtooth conjoint analysis computer program on which he relied, to replicate and test the assumptions in his analysis. Details regarding my work in these areas are in the appendices of this report

8. I have also conducted independent research into some economic issues that are relevant to issues in suit. Appendix C lists the materials available to me from the parties, as well as the materials I have independently gathered. I have cited to materials specifically relied upon in the footnotes of this report.

IV. Foundational Issues

9. Oracle asserts that the Google Android operating system infringes two Oracle patents (patents ‘104 and ‘520) and certain Oracle copyrights. While there are other copyrights at issue, I focus my attention on the 37 API copyrights that Oracle alleges to be infringed by Android.

10. When patents are infringed, a Plaintiff is entitled to recover damages that are no less than a reasonable royalty. When copyrights are infringed, a Plaintiff may also be entitled to recover damages that are no less than a reasonable royalty, although damages for copyright infringement may also be estimated based on the Defendant’s profits and, to the degree that there is no double counting, the Plaintiff’s lost profits.

11. With regard damages for infringement of one or more of the in-suit patents, Oracle is seeking a reasonable royalty. With regard to damages for infringement of the in-suit copyrights, Oracle is seeking a lost profits-related measure of damages or, in the alternative, a lost license fee (essentially a reasonable royalty). Oracle also claims disgorgement of infringer’s profits.

12. I understand a reasonable royalty to be the royalty that would have been the outcome of a licensing negotiation between Sun and Google at the time that infringement began,

where both are willing participants and both understand that the in-suit patents and copyrights to be licensed are valid and enforceable.

13. The seminal case with regard to a patent infringement reasonable royalty determination in the framework of a hypothetical negotiation is *Georgia-Pacific Corp. v. U.S. Plywood Corp.*[6] I discuss the *Georgia-Pacific* in Section VII.

14. Judge Alsup has indicated that "a reasonable royalty typically is determined from the 'hypothetical results of hypothetical negotiations between the patentee and infringer (both hypothetically willing) at the time infringement began.' *Mahurkar v. C.R. Bard, Inc.*, 79 F.3d 1572, 1579 (Fed. Cir. 1996). 'This hypothetical construct seeks the percentage of sales or profit likely to have induced the hypothetical negotiators to license use of the invention.' *Minco, Inc. v. Combustion Eng'g, Inc.*, 95 F.3d 1109, 1119 (Fed. Cir.1996)."

15. He further indicated that "Courts frequently allow experts to calculate a reasonable royalty percentage based on the value of the patents-in-suit to the infringer's revenue from the accused products. But in those cases, the next step is for the expert to calculate a reasonable royalty amount by multiplying the *infringer's revenues* and the reasonable royalty rate. *See, e.g.*, *Finjan Inc. v. Secure Computing Corp.*, 626 F.3d 1197, 1208–1211 (Fed. Cir. 2010)"[7]

16. This guidance informs my approach to damages in this matter.

17. I understand that a copyright owner alleging infringement can claim as damages its actual losses, as well as (to the extent not taken into account in an award for actual losses) the infringers wrongful profits. Actual losses may be calculated as a lost license fee, akin to the reasonable royalty damages for patent infringement damages. In this matter, Ora-

6 318 F. Supp. 1116, 1119-20 (S.D.N.Y. 1970), modified and aff'd, 446 F.2d 295 (2d Cir.); approved by the Federal Circuit in Unisplay, S.A. v. American Electronic Sign Co., Inc., 69 F.3d 512, 517 n.7 (Fed. Cir. 1995).

7 Tentative Order Granting in Part and Denying in Part Google's Motion in Limine #3 to Exclude Portions of Dr. Cockburn's Revised Damages Report 12/6/2011

cle claims a lost license fee based damage for the alleged copyright infringement. Thus, the guidance above regarding reasonable royalty also guides my copyright damages analysis.

V. Summary of Opinions

18. I conclude that the reasonable royalty negotiated between Sun and Google for use of the in-suit patents and copyrights would be a percentage of revenue royalty (or, equivalently, a per unit royalty), for a perpetual irrevocable license to the Sun Java ME intellectual property.

19. The reasonably royalty rate to which the parties would likely have agreed can be derived by calculation of the certainty cash equivalent value to both Sun and Google from the joint project that was contemplated in the 2006 negotiations between Sun and Google.

20. Those 2006 negotiations indicate that Sun expected to receive approximately [redacted] of the joint project benefits, while Google expected to receive approximately [redacted] of the benefits. Thus, I conclude the reasonable royalty for the total "2006 portfolio" of Java ME patents and copyrights is [redacted] of Android advertising revenues, or approximately [redacted] per handset.

21. [redacted]

22. There are good economic reasons that the above royalty rate should apply to the in-suit patents and copyrights, with no apportionment.

23. To the degree that the above royalty rate needs to be apportioned to the in-suit patents and copyrights, the Group and Value approach proposed by Prof. Cockburn provides a reliable method to accomplish this apportionment. However, analysis of a broader group of patent value studies indicates that the percentage of total patent portfolio value repre-

sented by the top 3.9% of patents in a portfolio is more likely to be approximately 53%, rather than the 77.1% estimated by Prof. Cockburn.[8]

24. The Shugan Conjoint analysis, as well as my revisions to the Cockburn Econometric analysis indicates the in-suit patents are worth approximately 80% of the value of the in-suit speed patent (the ‘104 patent).

25. Applying these apportionment ratios I conclude that the apportioned reasonable royalty for the ‘104 patent is [redacted] of Android revenues, the apportioned reasonable royalty for the ‘520 patent is [redacted] of Android revenues, and the apportioned reasonable royalty for the in suit copyrights is [redacted] of Android revenues.

26. If apportionment is required then these percentages should be applied to Google’s gross Android revenues through the date of trial to determine damages.

27. If apportionment is required then these percentages should be used as the going-forward royalty rates to be applied to Google’s future Android revenues.

28. The measure of infringer’s profits subject to potential disgorgement is approximately [redacted], through 2011.

29. [redacted]

[redacted]

31. The Shugan Conjoint analysis provides generally useful and reliable estimates of the relative value of the smartphone attributes that were included in the survey. As such, it also provides useful and reliable estimates of the relative value of these included phone attributes. The survey did not include some apparently important phone attributes. Thus,

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[8] Third Cockburn Report, Exhibit 34

the market share estimates produced by the Conjoint analysis may be biased. I am unable to determine the direction and extent of that potential bias.

32. The Cockburn econometric analysis provides generally useful and reliable estimates of the consumer Willingness to Pay for increased speed and an increased number of applications. The estimated Willingness to Pay for these phone characteristics is non-trivial, and indicates that the values of the in-suit patents and copyrights are non-trivial (assuming that Oracle's contentions about the performance improvements enabled by the in-suit patents and copyrights are correct).

VI. Bases for Opinions

A. Treatment of Technical Issues

33. The value of the patents and copyrights in suit is a function of (i) the improved performance that the use of the patents and copyrights confers on Android over the next best available non-infringing substitute; and, (ii) the value that end users of Android place on these performance improvements. While economists are well equipped to analyze (ii), they are not generally equipped to analyze, estimate or opine on (i). This is particularly true in this case where the product (Android), and the technical impacts and performance effects of the patents/copyrights on the product, are very complex. As an economist, I have to adopt assumptions about technical issues such as these, and base my opinions upon those technical assumptions.

34. Oracle has performed tests and offered estimates of the performance improvements made possible by the use of the patents and copyrights by Android. While Google disputes these estimates, it has not offered tests and estimates of its own. I am not in a position to evaluate the reliability of the Oracle tests and estimates, or the Google critiques of the technical aspects of these tests and estimates. Since Google has not offered alter-

native estimates of the performance impacts, if any, of the in-suit patents and copyrights, however, in what follows I base my analysis on the Oracle's estimates of the performance improvements. If Google presents alternative estimates of performance effects, I may incorporate those estimates into my analysis.

35. Speaking broadly, Oracle asserts the patents in suit confer large performance advantages (in particular large speed advantages) over the next best non-infringing substitutes. Similarly Oracle asserts that the alleged infringement of the copyrights in suit lead to a large increase in the number of applications available on the Android platform. There appears to be good evidence that consumers and OEMs, as well as Google, placed value on both the speed of the Android operating system and on the number of applications available on the Android platform.[9] Thus, as a general matter, *if* the jury finds that the in suit patents and/or copyrights allowed Android to be significantly faster and/or to have a greater number of applications than it otherwise would have had, I would advise the jury that these patents and copyrights have a high value. Moreover, as discussed herein, I believe the econometric and conjoint analyses employed by Prof. Cockburn provide useful – although far from perfect – measures of the value to consumers of attributes such as increased speed and increased availability of applications.

36. Conversely, *if* the jury finds that, absent infringement, Android would have been almost as fast and have almost as many applications (either because the patents and copyrights do not allow significantly increased performance or because good non-infringing substitutes exist), then I would advise the jury that the value of these patents and copyrights is relatively small.[10] In this instance, I still believe that the measurements of the value con-

9 This evidence is discussed in the Georgia-Pacific factor section of this report.

10 To possibly forestall the deposition questions, I do not have a quantitative measure in mind of what is "almost as fast" or "almost as many applications," nor do I have in mind a specific amount when I say "relatively small." I only intend by these comments to convey the common sense, but important, point that the greater the product improvement made possible by the allegedly infringed patents and copyrights, the greater the value of these patents and copyrights.

sumers place on speed and application availability are relevant, although these values would need to be applied to a smaller performance increment.

37. As discussed in more detail below, a similar issue arises in Prof. Cockburn's "Group and Value" method of estimating reasonable royalty damages. Under that method, the value of the patents is a function of (i) the technical importance of the patents in suit relative to other patents in the portfolio; and (ii) the typical distribution of patent value in a grouping of patents. Question (ii) is an issue that has been the subject of economic study, and on which an economist such as myself can usefully opine. Question (i) however, is a strictly technical issue on which economists have no expertise. Therefore, I limit my opinions to the issue of the likely relative value of the patents in suit, as a percent of the total portfolio value, given that the patents in suit fall within the some percentile of the distribution (in the top 3.9%, for instance).

B. Reasonable Royalty: Methodology

38. One way to think of the economic value of patents and copyrights is as the marginal (or incremental) value that the use of those patents or copyrights confers on the ultimate product in which they are embedded. This marginal value could come in the form of increased sales and/or higher prices and/or decreased costs. These effects follow from a simple profit function:

Profits = price x quantity – (variable costs x quantity + fixed costs)

39. In this case, the asserted value of the patents and copyrights is to increase the consumer desirability of the product. Moreover, since the product that is alleged to infringe (Android) is not sold, the value of the patents and copyrights is in any increase in the quantity of Android smartphones that results from use of these patents and copyrights. Prof. Cockburn has proposed a method to measure the incremental value of the patents and copyrights to the users of smartphones. While Drs. Leonard and Cox make some cri-

tiques and adjustments to Cockburn's valuation, they do not propose an alternative method for determining the contribution of the patents or copyrights to the value that consumers place on smartphones.

40. Prof. Cockburn used econometric estimates of the value that end users place on the increased functionality enabled by the in-suit patents and copyrights to predict changes in Android's market share. While this econometric analysis has been ruled inadmissible for the purpose of showing changes in Android market share, the econometric analysis is still useful to show changes in consumer willingness to pay for smartphones. [11] As I discuss below, I find Prof. Cockburn's method of valuing the marginal contribution of the patents and copyrights to be reliable and generally well implemented. Although I agree with some of Dr. Leonard's criticisms of the econometric analysis, these criticisms do not result in a lower estimated marginal value contribution of the patents.

41. The marginal value contribution of the patents and copyrights in suit is substantial.[12] Google would presumably have been willing to pay up to this amount for the in-suit patents and copyrights. Sun, on the other hand, would have accepted much less in a negotiation where the alternative was to lose the possibility of realizing any license revenue and the possibility of monetizing some version of Android that incorporated the in-suit patents and copyrights.

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[11] The Court ruled inadmissible Prof. Cockburn's estimates of the change in market share of Android based on the conjoint and econometric studies, although the Court did rule that the conjoint analysis was admissible for the purpose of determining the relative importance between speed and number of applications. See Order Granting in Part and Denying in Part Google's Daubert motion to Exclude Prof. Cockburn's Third Report, 3/13/2012. The Court did not expressly rule on whether the econometric analysis is also admissible to show the consumer value of smartphone attributes. I assume here that the econometric analysis is admissible for this purpose. If my assumption is mistaken, I will of course revise this portion of my opinion.

[12] Although it is a caveat I will not repeat throughout this report, at this early stage I reemphasize that this relatively large marginal value contribution is based on an *assumption* regarding the relatively large performance improvements enabled by one of the patents in suit.

42. Judge Alsup, in his July 22nd 2011 order[13] instructed the parties to consider starting with an offer made by Sun in February 2006[14] and make appropriate adjustments to that offer to reflect the differences between the scope of the actual negotiation in 2006 for, apparently, more than the in-suit patents and copyrights, and a hypothetical negotiation that is limited to the in-suit patents and copyrights. This approach has been adopted by all economic experts in this matter. I believe the 2006 negotiations do provide useful evidence on the likely value that each party brought to the table in the negotiations, and provide useful evidence on the likely outcome of a negotiation between Google and Sun for the patents and copyrights alone. Thus, I adopt this general approach, although with certain reservations about the economic justification expressed below. I also corroborate my conclusions from this analysis by reference to Sun's license with Danger, which I also believe to be relevant to the determination of a reasonable royalty in this case.

C. Determination of the Reasonable Royalty Rate Structure

43. I first consider the structure of the royalty agreement that the parties would likely reach in the hypothetical negotiation. I conclude that the agreement from that hypothetical negotiation would likely be a royalty based on a specified percentage of Android revenue or (approximately) equivalently, a per unit or per handset payment.[15] I reach this conclusion based on several considerations.

44. First, percent of revenue royalties are common in practice. These royalty structures efficiently spread the risk and upside potential between the licensor and licensee. Moreover,

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13 Order Granting in Part Motion to Strike Damage Report of Plaintiff Expert Iain Cockburn 07/22/2011, pages 14-15

14 OAGOOGLE 0100166873

15 If revenues per handset were known with certainty, a per unit payment and a percent of revenue payment could be made to be identical. While future revenues per handset are not known with certainty, these figures are commonly estimated and apparently relied on by Google and others. See Android P&L 3-Year Plan Model (GOOGLE-01-00004621.xls) , Project Armstrong: Business Model (OAGOOGLE 0100166873.PDF), and forecasts made by Strategy Analytics. Thus, I conclude there is no meaningful difference between a "percent of revenue" and a "per unit" royalty. I note that Dr. Leonard explicitly rejects a percent of revenue royalty structure (page 67 of his October 24, 2011 report), but advocates for a per unit royalty (page 117 of his October 24, 2011 report). I am unsure of the distinction he sees in these two royalty structures.

a running royalty based on a simple metric like revenues is easier to administer than a running royalty based on more complex accounting measures such as profits or "incremental revenues."

45. Second, I note that in its Order of July 22, 2011, the Court cited a case describing the reasonable royalty from a hypothetical negotiation as "the percentage of sales or profits likely to have induced the hypothetical negotiators to license use of the invention."[16]

46. Third, in the actual negotiation between Sun and Google, the discussion included a percentage-of-revenue component. I am aware that some of the offers from Google to Sun omitted the revenue sharing. However, under all offers, Sun was apparently going to have an opportunity to monetize a commercial version of Android. Thus the majority of Sun's compensation under the license would have come in the form of a per-unit payment. [redacted] Finally, Dr. Leonard advocates for a "per handset" approach in determining the future royalty rate.[18]

D. Determination of the Reasonable Royalty - Overview

47. I estimate a reasonable royalty for both the patents and copyrights with the following method. This method starts with the 2005-2006 actual negotiations between Sun and Google. The steps in this method are:

16 Order Granting in Part Motion to Strike Damage Report of Plaintiff Expert Iain Cockburn 07/22/2011, page 7.

17 Third Expert Report of Prof. Cockburn 2/3/2012, paragraphs 570-571.

18 Expert Report of Dr. Leonard 10/24/2011page 117. Dr. Cox does not appear to offer an opinion on damages from future infringement.

1. Review the 2005-2006 negotiations between Sun and Google and determine the likely agreement point in those negotiations.
2. Adjust the agreement point to determine the expected certainty cash equivalent of that agreement point for all patents and copyrights that were at issue in those negotiations. By certainty cash equivalent I mean the 2006 net present expected value to Sun of that agreement.
3. Estimate the expected 2006 present value of total Android revenues as of the time of the negotiation.
4. Using the results from (2) and (3) calculate the implied royalty rate – as a percent of Google Android revenues – for a license to use all patents and copyrights under discussion. I then validate this royalty rate by analysis of the Sun Java ME license with Danger.
5. Apportion the royalty from (4) to reflect a license for only the patents and copyrights in suit.
6. Apply the royalty rate from (5) to the actual Google Android revenues from 2008 to the date of trial in order to estimate the lump-sum past reasonable royalty patent damages in each of these years.
7. It is my opinion that the correct going-forward (post trial) royalty rate is the rate determined in (5).[19] If the court requests an annual lump sum figure for future reasonable royalty damages, I would apply the royalty rate from (5) to the most current forecast of

[19] It is unclear whether the issue of a future royalty remains part of my assignment. I include my opinions regarding future royalties here for completeness.

actual Android revenues (as for example, from the Google “Android P&L 3-Year Plan Model[20]).

48. Under the structure discussed in the 2005-2006 negotiations, the development and commercialization of Android would have been a joint effort between Sun and Google. Sun would have contributed certain assets and efforts – including the patents and copyrights in suit, but also other contributions – and would have received certain benefits, including fixed and variable cash payments from Google, as well as an opportunity to monetize a royalty-bearing version of Android and associated value-added services. Google would contribute certain assets and efforts – including financial assets, knowhow, and reputation. The total discounted expected value of Android revenues ranges from [redacted] depending on the assumption I adopt regarding the 2006 expectations of Android success. The (very) wide variation in these estimates is because the Google business forecast I use has two widely varying estimates of future Android unit shipments. Derivation of this expected value is discussed in Section VI.8.

49. I then convert the non-patent and non-copyright Sun contributions and benefits into a certainty cash equivalent value. These “upward and downward” adjustments are discussed in Section VI.7. I conclude that the certainty cash equivalent value (the amount that Google would have paid Sun in a lump-sum cash payment for rights to use all the patents and copyrights under discussion in 2006) ranges from [redacted] Again, the wide variance in these estimates is due to the variance in Google forecasts of Android success.

50. This implies a royalty rate of approximately [redacted] of Google Android revenues, or approximately [redacted] per handset. [redacted]

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[20] GOOGLE-01-00004621.xls. This forecast dates from 2008 and I expect a more recent forecast is available, although I have not identified such a forecast at the time of the writing of this report. In what follows I apply my reasonable royalty percentage to the forecasts from this 2008 Google model, although I would update the calculations to a more recent forecast if one is identified.

[redacted]

51. The hypothetical license would encompass only the two patents in suit as well as the API copyrights in suit. I adjust the total 2006 portfolio royalty rate of [redacted] downward to reflect the more limited scope of the hypothetical license. This adjustment is based on the proportional value of the in-suit patents and copyrights to the value of the entire 2006 portfolio. This proportional valuation is based on Prof. Cockburn's Group and Value analysis. That analysis indicates that the '104 patents represent approximately [redacted] of the value of the 2006 portfolio, the '520 patent represents approximately [redacted] of the value of the 2006 portfolio, while the copyrights represent [redacted].[21] Applying these adjustments, the equivalent apportioned royalty rate for the '104 patent is approximately [redacted]) of gross Android revenue, the equivalent apportioned royalty rate for the '520 patent is approximately [redacted] ([redacted] , while for the copyrights the apportioned royalty rate is approximately [redacted] ([redacted]).

52. The same royalty rate applies going forward. To the degree the Court wishes an opinion on a lump sum figure for future royalties, I would apply this percentage of the best current forecast of Android advertising revenues.

E. Expectations Regarding Android in 2006

53. My method for calculating a reasonable royalty relies on the expectations of Sun and Google as of 2006. This is consistent with theory and common practice. It does, however, present a practical problem in this instance since I do not have good evidence on the quantitative 2006 expectations of Google and Sun regarding the likely success of An-

[21] I base the relative value of the copyrights on the results of Prof. Shugan's conjoint analyses, as well as my modifications to Prof. Cockburn's econometric analysis.

droid. Prof. Cockburn produces qualitative evidence that Google and Sun expected in 2006 that Android would be a great success. Drs. Leonard and Cox present qualitative evidence that Google and Sun were more pessimistic about the prospects for Android.

54. Typically, an expert would look at the parties' internal business projections and investment analyses in order to understand the parties' expectations. Ideally, the expert would be able to probe the basis for the projections (either through interviews or depositions) and evaluate the reliability and rigor of the projections. However, in this case, few such projections exist. From Sun I am aware of only the Project Armstrong projections. Google asserts that the rigor and support for these projections is unknown, and that they are unreasonably optimistic. The projections for unit shipments of Android phones in this business plan are approximately twice as high as actual shipments have tuned out to be. While this does not mean the projections were *ex ante* unreasonable, it does raise some doubt (although it could be that the projections were too optimistic about the ramp-up period, but not the overall success). Moreover, I am not aware of any evidence of the basis for the projections. Thus, I am unable to evaluate the rigor and reliability of these forecasts.

55. The earliest Google forecast of the Android units and revenue-per-device of which I am aware is from 2008.[22] Obviously, both the Android project and the smartphone market had evolved in significant ways from 2006 to 2008. Moreover, this Google business plan contains two sets of forecasts, each with three separate cases. While the "cases" within each forecast type anticipate roughly similar business results, the two forecast types (one dubbed an "Internal" forecast, and one dubbed a "Market" forecast) anticipate very differ-

22 Android P&L 3-Year Plan Model (GOOGLE-01-00004621.xls).

ent outcomes. The differences in these forecasts have been discussed by Prof. Cockburn and illustrated in Exhibit D1 to his September 12, 2011 report.[23]

56. As a result, the evidence I have regarding the expectations of Google and Sun in 2006 for the likely success of Android is sparse and does not point in the same direction. I appreciate the approach of Prof. Cockburn of using actual Android sales as a proxy for the parties' 2006 expectations. Under rational expectations, on average (but not in every instance) expectations should approximate actual results. Moreover, as Prof. Cockburn demonstrates the (widely varying) Google forecasts from 2008 bracket the actual Android sales figures that he uses. Nevertheless, I believe it is more appropriate to attempt to use the earliest Google forecasts available. In doing so, I perform my calculations using both the (more optimistic) Market projections as well as the (less optimistic) Internal projections. In order to be consistent, I use the same two projections of total Android sales (or installed base, converted to sales) to calculate the 2006 expected value of Sun's Project Armstrong.

57. Note that as long as the Sun and Google expectations in 2006 regarding Android were consistent, the level of these expectations is largely irrelevant. The value of the 2006 portfolio to Sun is proportional to the success of Android since the vast majority of the value Sun would have expected to receive under that agreement would have come in the form of profits from offering a commercial version of what became Android. Obviously, the expected value to Google of the Android project is also proportional to the success of

[23] The differences in the Internal and Market forecast appear to be even larger than Prof. Cockburn illustrates. The Internal forecast appears to contain a formula error that, when corrected, significantly lowers the estimated US installed base on Android phones.

Android. Since the royalty rate is the ratio of these two expected values, the market success (measured as number of activated Android handsets) drops out of the calculation.[24]

F. Determination of the Likely 2006 Agreement Point

58. As noted above, all the economic experts in this matter base their reasonable royalty damages opinions on the likely terms of agreement from the 2005/2006 negotiations between Google and Sun. However, the experts disagree on what these likely terms of agreement would have been. Prof. Cockburn adopts the terms of the February 8, 2006 offer from Sun.[25] [redacted]

59. The possible agreement being discussed between Sun and Google in 2006 was complex, and terms other than the upfront payment (which is the focus on the dispute between Prof. Cockburn and Drs. Leonard and Cox) appear to have differed among these

[24] This is approximately, but not strictly, correct. Since there were relatively small upfront components to the deal – such as the three annual payments to Sun – that were not proportional to the expected number of Android handsets, the calculated royalty rate varies slightly when the estimated number of Android handsets is increased or decreased.

[25] February 8, 2006 email to Google, OAGOOGLE0000357494.pdf and April 10, 2006 email to Google, GOOGLE-01-00065669.PDF.

[26] April 18, 2006 email, OAGOOGLE0000358127.pdf.

offers as well. Thus, it is not sufficient to simply compare the upfront payment terms, while ignoring other changes in the terms of the potential agreement.

60. To make sense of the offers or partial offers it's helpful to distinguish between simple contracts where the only matter being discussed is the price and complex contracts where terms in addition to the price are at play. A negotiation can focus solely on price. In the haggling that typically accompanies the purchase of an Oriental carpet, for an example, the implicit assumption, presumably held by both the buyer and the seller, is that if the seller lowers his asking price, he's offering the same carpet, and, conversely, if the buyer responds in the back and forth of offer and counter offer by raising her offer price, it's for the carpet that has been, to that point, the subject of the negotiations.

61. By contrast, in many negotiations the parties make offers where price and non-price aspects of a deal change simultaneously. A seller might respond to pressure from a buyer for a better price by offering a lower price but also change some other, non-price, aspect of the deal in ways that are more favorable to the seller. For example, a seller might lower the price but also change credit terms in ways that he finds more favorable. Alternatively, a buyer might respond by conditioning a higher price offer on the seller providing a warranty or service that was not included in the seller's previous price offer. Essentially, in this kind of setting, the parties can trade off non-price provisions against price. Put somewhat differently, a seller may be able to extract value in several ways. A change in one area (a lower price, for example) can be partially or fully offset by a change in another area (for example, a reduced service commitment). As a consequence, non-price aspects of a deal that are less favorable to the seller can be compensated for, in part or fully, by a higher price and vice versa.

62. Sun's February 2006 offer was just such a "complex contract." [redacted]

[redacted]

63. [redacted]

64. Second, while Dr. Leonard might argue that Sun's expectations with regard to the money coming to category (iii) are too optimistic, this argument is mostly irrelevant: were Sun less optimistic about the revenue coming to category (iii), it would presumably expect more money to come to categories (i) and (ii). [redacted]. Dr.

Leonard's adjustments of one source of revenue (adopted by Dr. Cox), without providing supportive evidence that other terms would not have changed, is inappropriate.[27]

65. Third, both Drs. Leonard and Cox argue that a Sun offer subsequent to the February 2006 offer with less money in category (i) should be used as the starting point for the hypothetical negotiation. [redacted] Because the terms of the February 2006 offer were more explicitly spelled out, I conclude that this offer provides the best representation of the terms of an agreement between the parties.

66. In any event, the differences between Prof. Cockburn and Drs. Leonard and Cox on this issue are largely immaterial. These differences appear material due to the (incorrect, in my view) way that Prof. Cockburn and Drs. Leonard and Cox treat past reasonable royalties as distinct from future royalties. As discussed below, their approaches have the effect of "front loading" all of the upfront payment into a few years. However, when the upfront payments are amortized over the life of the hypothetical license [redacted] Thus, I do not believe the specific amount of upfront payment under the hypothetical license to be important in the determination of reasonable royalty damages. In my analysis that follows I adopt the "$100 million" offer as the likely point of agreement between the parties.

[27] In determining the 2006 value of February 2006 offer, I substitute Google's projected Android sales for Sun's projected Android sales in Project Armstrong without adjusting the terms by which money came to categories (i) and (ii). While it might appear that this substitution is subject to my criticism of Dr. Leonard's adjustment, the effect in my case is to reduce the 2006 value of the February 2006 offer, thereby providing a conservative estimate of the reasonable royalty in my methodology.

G. Converting the "$100 million" Sun Offer to a Certainty Cash Equivalent

67. Having concluded that the "$100 million" Sun offer to Google represents the best estimate of the likely agreement point on the broader agreement between Sun and Google, I convert that offer to a 2006 certainty cash equivalent for all the in-suit and not-in-suit patents and trademarks under discussion. Put another way, I consider all other aspects of the broader agreement and convert them to a 2006 cash value to either Sun or Google in order to estimate the lump sum cash payment that Google would have likely made to Sun solely for a license to the all the patents and copyrights under discussion.

68. In my review of the 2005-2006 negotiations, and materials from this lawsuit discussing those negotiations, I have identified the following deal components that were under discussion.

[redacted]

- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]

[redacted]

69. I first reduce elements (1) and (2) above to a certainty cash equivalent value. In doing so, [redacted] I calculate expected Android revenues based on the earliest forecast of Android revenue of which I am aware.[29] Consistent with my discussion above, I perform this calculation using both the (higher) Google "Market" forecast as well as the (lower) Google "Internal" forecast. In both instances, I use the "Case 1" scenario.[30] In both instances, the Google forecasts only forecast Android units and advertising revenue for 3 years. Prof. Cockburn extends these forecasts using more recent forecasts from Strategy Analytics. I adopt this extension of the Google forecasts in my analysis.

70. In performing this calculation, I do not adopt Prof. Cockburn's suggestion [redacted] I agree with Prof. Cockburn that the 2006 negotiations pertained to a compatible version of Java ME, while the hypothetical negotiation pertains to an incompatible version. I agree with Prof. Cockburn that the difference between a compatible and incompatible license would likely be material to Sun and believe there is evidence that Sun cared about preventing the fragmentation of Java. [redacted]

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[28] Drs. Leonard and Cox propose a discount rate of [redacted] Leonard's Revised Report dated 10/24/2011 page 87. Dr. Cox notes that the 2010 cost of capital for SIC code 737 – which includes Sun– was [redacted] Cox's Revised Report dated 10/21/2011 page 34 and backup to his exhibit 3c. Thus, I conclude use of a [redacted] discount rate is conservative in this instance.

[29] See GOOGLE-01-00004621.xls "Android P&L 3-Year Plan Model".

[30] Each of the Internal and Market forecasts have 3 cases: Case 1 (called "Target" or "Base"); Case 2 (called "Stretch 1" or "Optimistic"); and Case 3 (called "Stretch 2" or "Upside Case"). I adopt the Target case for my analysis.

[redacted]

71. I next calculate the expected value of the Sun opportunity to provide a commercial implementation of the mobile device operating system (i.e., Project Armstrong). In performing this calculation I adopt Dr. Leonard's suggestion that the projected Sun profits should be discounted in order to be brought to an expected present value, and I adopt the [redacted] discount rate suggested by Dr. Leonard. I also agree with Dr. Leonard that the operating expenses need to be subtracted from the projected Sun revenues in order to estimate the cash equivalent of the Sun monetization opportunity. I do not agree with Dr. Leonard that the projected Sun sales need to be reduced to reflect only the commercial portion of the mobile stack implementations. As Prof. Cockburn points out, the Sun projections already account for the commercial/open source split, [redacted].[32]

72. In converting the Project Armstrong projections to a 2006 certainty cash equivalent. I replace the projected total market sales from the Project Armstrong forecast with the projections from the 2008 Google forecast. Thus, I treat the market expectations consistently in both the numerator and denominator of my reasonable royalty calculation. I adjust the projected Sun expenses associated with Project Armstrong proportional to my adjustment in the total market size. While some of the Sun expenses may be fixed over some range of potential sales, the variation in projected Android adoption (and thus Sun sales of commercial implementations) is very large, both across the two forecasts and within the

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[31] [redacted]

[32] See "Project Armstrong: Business Model" dated February 2006, OAGOOGLE 0100166873 at 83.

forecasts through time. Over this range of commercial activity, it is more reasonable to assume that costs will be roughly proportional to sales units and revenues.

73. I next consider the value to Google of the technical assistance that Sun was anticipated to provide Google in the development of the mobile stack. I believe that Prof. Cockburn, in his recent report (dated February 3, 2012), provides a reasonable estimate [redacted] of this amount. In coming to this conclusion, I consider Dr. Leonard's observation that this number is the *cost* to Sun, not the *value* to Google. However, I would not expect the cost to Sun to differ significantly from the value to Google. The value to Google of the Sun technical assistance would be the avoided cost of Google having to do the work itself. In developing a product like Android, both Sun and Google would employ the same assets: experienced software engineers.[33] Both Sun and Google would be expected to pay these engineers about the same productivity-adjusted amount. Thus the cost to Google to do what Sun would otherwise do for it should be approximately equal to the cost to Sun of performing that same work.[34]

74. I make a $37 million additional downward adjustment for the "fact" that the 2006 negotiation included Sun providing to Google the source code for the Java Virtual Machine while the source code would not be a component of the hypothetical negotiation.[35] This valuation is based on guidance from the Court in its March 13, 2012 Order.

75. [redacted]

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[33] I understand that the Google development team for Android included former Sun engineers.

[34] I note that in his most recent report, Dr. Cox apparently believes that the cost Sun would have incurred under Project Armstrong fully captures the value to Google of Sun's anticipated technical assistance under the 2006 negotiations. (See paragraph 26 and Exhibit 1 [row b]) of the Feb 17, 2012 report of Dr. Cox.)

[35] I do not put the word fact in quotes to indicate I question this as a fact. However, I have not seen this component of the negotiations mentioned in any documents contemporaneous with the negotiations.

[redacted]

76. I do not believe that there is any additional upward or downward adjustment warranted for the compensation to Sun for this short term revenue losses due to the open sourcing of Java ME. [redacted].[37] Thus no upward adjustment is needed. Similarly, in the hypothetical negotiation Sun would seek compensation for its revenue losses due to the open sourcing of a close substitute to Java ME. Thus, no downward adjustment is warranted.[38]

77. I do not make any adjustment for the recruiting of OEMs and service providers. First, this responsibility and assistance appears to have been reciprocal. [redacted].

78. I do not make any adjustment for the time to market advantage, although I do so with reservations. There is some evidence that Google and Sun expected that the collaboration between the parties would accelerate the development and launch of Android,[40] and time to market appears to have been an important consideration for Google.[41] However,

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[36] See paragraphs 50, and 388-389 of the same report.

[37] Dr. Leonard suggests that the upfront payments that were discussed in the 2006 negotiations were compensation for the Sun business risk. (See page 54 of the Oct 24, 2011 report of Dr. Leonard.)

[38] This is another example of a point I made earlier: What Sun knew in 2006 about its Java ME business and Sun's expectations with regard to the effects of an agreement with Google for an open-source Java-VM Android on its Java ME business would be fully reflected in its 2006 offer.

[39] Leonard Revised Report 10/24/11 Section III. B. 4. d.; Cox Revised Report 11/28/11 Section IV F. 2. d.

[40] GOOGLE-12-00079180-194 at 186, "Why Do the Deal? ... Dramatically accelerates our schedule."

[41] Third Expert Report of Prof. Cockburn 2/03/12 Section IX. E.

I do not have sufficient evidence on which to base such an adjustment and note that neither Dr. Leonard nor Dr. Cox offers a measure of this value to Google. [redacted] Thus, I conclude that omitting this adjustment does not materially bias my conclusion.

79. Finally, I make no adjustments for the provision to Sun by Google of Google-owned handset technologies. Sun, through Prof. Cockburn, has not asserted this component of the 2006 deal had significant value, which suggests that it did not. Moreover, the value to Sun of these technologies would presumably be captured by Sun's participation in the mobile device market, most likely through Project Armstrong. Thus, this value to Sun has already been captured in the Project Armstrong calculations above.

80. Based on the analyses above, I conclude the 2006 certainty cash value of the "$[redacted]" Sun offer was [redacted] See Tables 1 and 2.

81. Since this amount is larger than the [redacted] suggested by Prof. Cockburn or put forward by the Court in its March 7, 2012 order, a word of explanation: I have assumed, as I believe to be correct, that had a royalty been determined in 2006, it would have been for the life of the patents. As such, the certainty cash equivalent should account for the expected Sun revenue over the life of the license, not just the period between the license negotiations and the date of trial (or any other period less than the life of the license). The record does not contain Sun or Google projections for the entire life of Android or Sun's Project Armstrong, but, the valuation of the 2006 offer should include the parties' future expectations held at or near the time of the 2006 negotiations. These expectations extend beyond the date of trial and should be considered in determining the 2006 certainty cash value, even if the Sun business projections for Project Armstrong do not. The Google projections – as extended by Prof. Cockburn – extend the furthest into the future,

hence I use those projections to value Project Armstrong and [redacted]

82. I believe Prof. Cockburn errs in arguing that there should be a "to-date-of-trial" royalty for the period to the date of trial and then a separate negotiation for a "going-forward" royalty for the remaining life of the patents from the date of trial.[42] This leads Prof. Cockburn focus on the value of the 2005 deal to Sun through 2011, and then to apportioning this amount to the patents and copyrights in suit. Drs. Leonard and Cox adopt and follow Prof. Cockburn's error, when they also focus on the value of the 2006 deal to Sun through 2011, and then undertake an apportionment of that value. That this is a mistake is easy to see. Prof. Cockburn estimates that the lump sum cash value of the total 2006 deal to Sun is [redacted] He also reports that total Google Android-derived revenues through 2011 are [redacted] [43] Thus, Prof. Cockburn concludes that Google would have paid a royalty equal to almost all of its Android revenue for a license (from 2006 through 2011) to the entire portfolio of Sun Java intellectual property. This cannot be correct.

H. Estimating the 2006 Expected Value of Android Revenues

83. I next calculate the 2006 expected value of Android revenues based on the Case 1 (i.e., the "Target" case) for both the "Internal" and "Market" Google forecasts.

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42 [redacted]

43 See Exhibit 19 to the February 3, 2012 Cockburn report. Dr. Cox asserts that Google's Android-derived revenues through 2011 are [redacted] (See Exhibit 3b to the October 21, 2011 Cox report.) This difference is immaterial to my point here.

84. Note that I calculate total Android revenues, not incremental revenues (Android revenues net of the "re-capture" that Google would experience from revenues gained by Android users switching to other smartphone platforms). As discussed above it is my opinion that, under the hypothetical negotiation Sun and Google would have agreed to a percentage royalty, with this royalty on actual – not incremental – Android revenues. I conclude that the royalty would be based on actual Android revenues – not incremental revenues – because actual revenues are easier to monitor, while incremental revenues require complex calculations and assumptions about "but-for" shares of other smartphone platforms, search intensity and search engine choice on these platforms, and Traffic Acquisition Costs on these platforms.[44]

85. The 2006 expected value of Android revenues ranges from [redacted] (using the "Internal" forecast) to [redacted] (using the "Market" forecast). See Tables 1 & 2.

I. Calculation of the Equivalent Percentage Royalty Rate of the February Sun Offer

86. Dividing the 2006 certainty cash equivalent value of Sun's offer into the 2006 expected value of Android revenues results in a ratio of about [redacted] However I believe this overstates the likely royalty that would have been agreed to in the hypothetical negotiation. Taking the "Internal" forecast as an example, the expected present value to Sun is [redacted] and the expected present value to Google is [redacted] While the Sun expected benefit is approximately [redacted] of the size of the Google expected benefit, one is not at the expense of the other. In other words, under the transaction contemplated in 2006, Google would not pay Sun [redacted] of its revenues in license fees. Rather, most of Sun's expected benefit from Android was in the form of profits from *its* commercialization

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[redacted]

of the jointly-created mobile device operating system (i.e., Android). Thus, the total expected value of the transaction is the sum of the Sun expected benefit [redacted] and the Google expected benefit [redacted]), or [redacted] Of this total expected benefit, the Sun expected benefit is approximately [redacted]. Thus I conclude that the equivalent royalty percentage from the hypothetical negotiation (as a percent of Android revenues) would have been [redacted].[45]

J. Evaluation of the Implied Royalty from the Danger-Sun license

87. [redacted].

88. In [redacted]

[45] [redacted]

[redacted]

89. [redacted][48] [redacted]

90. [redacted] . [redacted][50]

91. [redacted]

[46] Expert Report of Dr. Leonard 10/24/2011, pages 46-47.

[47] [redacted]

[48] Expert Report of Dr. Leonard 10/24/2011, page 47. Elsewhere in same report (page 48) "This adjustment is conservative…"

[49] [redacted]

[50] [redacted]

92. [redacted][51]

93. [redacted][53]

94. Dr. Cox indicates that for the same period of time, "Android Gross Ad Revenues" totaled [redacted][54] [redacted]

95. [redacted]

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51 [redacted]

52 I note that Dr. Cox adopts Dr. Leonard's reasonable royalty analysis and incorporates Dr. Leonard's Exhibits 3b.1, 3b.2, 3.c and 3.d into his Exhibits 6b.1, 6b.2, 6c and 6d.

53 [redacted]

54 See Exhibit 2.a, Expert Report of Dr. Alan J. Cox, revised October 21, 2011.

[redacted]

96. [redacted]

K. Allocation of the 2006 IP Portfolio Value to the Patents in Suit - Theory

97. As I understand the matter, the law requires that the reasonable royalty be determined just prior to infringement based on a hypothetical negotiation between the two parties over just the patents in suit, assuming that both are willing participants in the negotiations and that the patents are valid and enforceable.

98. The hypothetical negotiation is, of course, a fiction. Even so, in many cases one can imagine that such a negotiation could have occurred because there are either negotiations over one or more in suit patents in other settings or there are negotiations for patents that are similar to the in suit patents, either of which can be used to benchmark the value of

the in suit patents. So while the hypothetical negotiation imagined for purposes of determining damages in a specific litigation setting is a fiction, negotiations of the sort envisioned by the hypothetical negotiation are not fictitious.

99. In this case, however, none of the experts has cited to any evidence that Sun ever negotiated licenses for individual patents or for small subsets of its IP portfolios. To the contrary, it appears that Sun's negotiations with various parties were always for a Java IP portfolio, often only vaguely specified,[55] whose components were useful in specific implementations of Java ME or, more generally, other Java operating systems and products.[56] As a consequence, in this case (and in cases of this sort), there is a double fiction: a damages expert is asked to imagine a hypothetical negotiation for a subset of an IP portfolio in the face of the fact that there aren't real-world negotiations for subsets of IP portfolios, but only real-world negotiations for the IP portfolios themselves. This puts economists in a precarious position in that they generally look first to market evidence for determining or benchmarking valuations and, barring market evidence, to cost-based valuations or benchmarks. For subsets of IP portfolios there are neither. Moreover, as is well recognized in economics, when the patents in a portfolio are complements and/or substitutes for other patents in the portfolio, there is no unique way to apportion the value of the portfolio to individual patents.

100. Moreover, note that in 2006 if Sun and Google understood that the subset of Sun's Java ME IP portfolio most relevant to their negotiations was composed of the now in suit

[55] See, for example, paragraphs 1.27, 3.1 (d) and (e) in draft agreements from the 2006 negotiations (GOOGLE-01-00062072.PDF).

[56] An IP portfolio could be simply an aggregation of patents and copyright that might be useful to a particular end product which enable various technological components of the end product but are otherwise technologically unrelated. For example, one could think of the patents that enable all of the functionalities – a phone function, a Web browser, a computer for executing applications, a screen interface – of an iPhone as a portfolio. Or an IP portfolio could be a group of patents which enable a particular technology. For example, one could think of the patents tied to the iPhone's iOS operating system as a portfolio. In this report, I use the term "portfolio" in latter sense since the Java ME IP portfolio presumably contained the Sun intellectual property useful for versions of the Java ME operating system, including those for the Java ME virtual machine and the APIs useful to application developers using the Java language.

patents and copyrights, the 2006 value of the Java ME IP portfolio *is* the value of the in suit IP. Put directly: If Sun and Google knew which subset of Sun's Java ME IP would be needed to implement a Java-based VM in Android, then that's what would have driven the negotiations and the aggregate value of the license in the 2006 negotiations is attributable to this subset.

101. If, however, the subset of Java ME IP useful to Android wasn't known by the parties in 2006, then a hypothetical 2006 negotiation that is based on ex post (2010) information about the subset that "turned out to be" useful undervalues, perhaps substantially, the in-suit IP. The reason is that if Google knew that it needed a subset of the Java ME IP portfolio, but didn't know in 2006 which subset it needed, then the 2005/06 negotiations can be thought determining the value of an option to, at some later date, decide which, if any, subset of the Java ME IP portfolio to use and when to use it.[57] In this case, the 2006 value of the in suit IP is also the 2006 value of the Java ME IP portfolio – essentially the aggregate value of the 2006 Java ME IP license is what Sun was willing to accept for an option for Google to use one, two or as many of the patents and copyrights in the Java ME IP portfolio as it wished and, hence, the amount paid for the option to use what turned out to be the in-suit IP.

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[57] For instance, the formerly in-suit '205 patent enabling the JIT functionality, wasn't allegedly infringed until after the other in-suit patents were infringed. A strict interpretation of the "hypothetical negotiation just prior to infringement" means that instead of thinking of all of the in-suit patents as part of the 2005/06 negotiations, the date of the hypothetical negotiation for at least one – the '205 patent – would be separated from the others. While it is my understanding that the value of a patent in a hypothetical negotiation cannot be determined by its "hold up" value, it is also my understanding that a factor to consider in the hypothetical negotiation is the relative bargaining strength of the two parties at the time of infringement. Google's bargaining power at the point of infringement of this particular patent (apparently, in or after 2008) would be quite different than its bargaining power for the other patents in early 2006 for two reasons: Google had (further) committed to a Java-based VM after 2006 and this commitment narrowed the available options. Both suggest that Google was in a weaker position vis a vis the hypothetical negotiation for the '205 patent than it would have been vis a vis the other in suit patents. An advantage of a portfolio license is that, within the period covered by the license, it allows for timing of patent use without concern for hold up problems of this sort. This is a valuable "option" that should also have been included in a reasonable royalty for the '205 patent if this patent was included in the 2006 hypothetical negotiations or, alternatively, the hypothetical negotiations for the '205 patent should take into account the circumstances just prior to its infringement in 2008 or beyond.

Put somewhat differently, a portfolio license is useful precisely because it eliminates the "hold up" problem for patents implemented after a firm has committed itself to a particular technological path.

102. Another approach to a 2006 hypothetical licensing negotiation that gets to the same outcome assumes that Sun's Java ME IP wasn't directly portable to what Google envisioned it needed for a Java-based operating system for smartphones.[58] If Google was interested in writing a from-the-ground-up operating system but decided that it needed it to be written in Java and based, at least in part, on Java ME "like" technology to appeal to potential applications developers and OEMs, then since Sun had solved lots of the problems of implementing a Java-based VM on small devices and had patented these solutions, Google might reasonably have assumed that in the course of its from-the-ground-up development it would face some of the same problems. Since it was writing in Java, it would likely solve some of these problems in the same way that Sun had previously done, thereby infringing Sun's patents. In this case, the value of 2006 negotiations for Sun's Java ME IP portfolio can be thought of as insurance against litigation if it happened to turn out that Google solved the problems it faced in writing Android in the same way Sun had solved them, thereby infringing Sun's patents.

103. Finally, to the degree that the patents and copyrights in an IP portfolio are, as appears to be the case in this matter, useful in implementing a particular technology (e.g., a Java VM), some elements of the portfolio are likely to be substitutes for one another and other elements are likely to be complements. One might expect substitutes to develop within a portfolio, in part, as a way of enhancing the value of a critical patent—a patent thought to be critical would have greater value if "best" alternatives to the use of the patent were also patents within the portfolio. Put differently, a clever innovation that has good non-infringing substitutes is worth less than the same innovation when there are few or no non-infringing substitutes. Likewise, one might expect complements to develop

[58] The behavior of Google and Sun suggest that this is probably true in this the case. That is, as I understand the record, Google wanted to develop a new operating system for smartphones, albeit it one based (partially) on Java. That Sun purchased SaveJE as the basis for its separate, but later aborted, development of a smartphone OS also indicates that the 2006 Java ME IP was not directly useable as a smartphone platform or virtual machine.

within a portfolio as inventors find ways to extend the functionality enabled by one or more critical patents through synergies. The synergies could be substantial and the portfolio valuable precisely because two or more patents, or a patent and copyrighted elements, were together of great value but separate of little value. As a consequence, both licensee and licensors would insist on portfolio, rather than patent-specific or copyright-specific licensing.[59]

104. In sum, the Court asked for my best economic advice. Setting aside what the law may require, my best economic advice is that there are good economic reasons why value of the in suit IP in this matter is the 2006 value of a hypothetical negotiation for the entire Java ME IP portfolio and the reasonable royalty rate is [redacted]

105. If, as I understand the matter, valuing the specific in suit IP by considering a hypothetical negotiation for the entire portfolio is not permissible, the above arguments are still useful because they suggest a simple apportionment of the in suit IP as a fraction of the value of the portfolio will underestimate the value of the in suit IP. Such an apportionment is likely to ignore the option value (in terms of providing Google the choice of which Java ME IP to utilize, and importantly, when to utilize Java ME IP) and/or the value of insurance against litigation should the "independent" development of Android cross the boundaries of one or more Java ME patents. In short, in actual negotiations, a party would have had to pay something for the option that it, in a sense, later exercised and the hypothetical negotiation should account for this. My apportionment below does not account for this option or insurance value and thus understates the royalty from the apportioned hypothetical license.

[59] The existence of substitutes and complements within a portfolio also makes accurate apportionment to subsets of patents or copyrights within the portfolio difficult, if not impossible without a detailed understanding of which patents and copyrights in a portfolio are substitutes and complements for one another. In particular, the number of patents or copyrights infringed relative to the value of the portfolio is irrelevant in determining the value of the infringed patents or copyrights.

L. Allocation of the 2006 IP Portfolio Value to the Patents in Suit

106. In order to allocate the 2006 portfolio royalty rate of [redacted] to reflect a royalty rate for just the patents and copyrights in suit, I rely on the general method employed by Prof. Cockburn in his Group and Value approach. I have considered the objections to Prof. Cockburn's Group and Value method raised by Dr. Leonard, and while those objections have some merit, I find this general approach to be reliable and to be the best available method to allocate the total 2006 portfolio royalty to the in-suit patents and copyrights. I discuss in Appendix D my evaluation of Dr. Leonard's objections and the modifications I make to Prof. Cockburn's analysis.

107. [redacted]

108. Based on results from the conjoint analysis, Prof. Cockburn concludes that the copyrights in suit are worth approximately half the patents in suit.[61]

109. Prof. Cockburn then identifies three academic studies of patent value. Taking the data on patent value from these studies, he plots the distribution of patent value, fitting a "Pareto" distribution. He concludes that in these studies the top 3.9% of the patents represent 67.9%, 77.1% or 91.9% of the total value of all patents in the study, depending on

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60 Third Cockburn Report 2/3/2012 p.150 (paragraph 397).

61 This conclusion applied to the case when there were 6 patents in suit. There are now 2 patents in suit. I believe that the same general ratio will apply. The 2 to 1 ratio from the conjoint analysis related to the relative consumer preference for start-up speed versus number of applications. The former is the effect of infringement of (some of the) in-suit patents while the latter is the result of infringement of the copyrights. There were two in-suit patents that were associated with increased start-up speed, and the primary one of those was the 104 patent. Due to apparent complementarities, the other speed patent – the 205 patent – cannot operate in the absence of the 104 patent. Thus, the 104 patent is essential to obtain the benefit of the 205 patent. Since I understand the 205 patent has been rejected by the PTO, its use is free. Therefore, the value of the 104 patent includes the value of the incremental speed that is enabled by the (freely available) 205 patent.

the study utilized.[62] [redacted]

110. As discussed in Appendix D, I believe that analyses of the distribution of patent values from studies like those referenced by Prof. Cockburn are useful in allocating the value of a portfolio of patents to the value of individual patents in that portfolio. I also conclude that the conjoint analysis and my revision of Prof. Cockburn's econometric analysis indicates that the value of the copyrights is approximately 80% of the value of the '104 patent However, after reviewing a larger range of patent valuation studies, I believe that Prof. Cockburn's conclusion that the top 3.9% of patents in that portfolio represent 77.1% of the portfolio value is too high. Based on my analysis, I believe a more reliable estimate is that the top 3.9% of patents in a portfolio represent about 53% of the portfolio value. I explain my reasoning and analysis in Appendix D.

111. If the value of the top [redacted] in the 2006 portfolio represent [redacted] of the value of the entire portfolio, then the '104 patent represents [redacted] of the value of the 2006 portfolio, and the copyrights represent [redacted] of the value. Applying these apportionment percentages to the [redacted] royalty for the entire 2006 portfolio results in a royalty for the '104 patent of [redacted] and a royalty for the copyrights of [redacted] The royalty rate for the '520

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62 Third Cockburn Report 2/3/2012 exhibit 34

patent is [redacted].[63] See Table 7. Rounding these royalty rates I conclude the apportioned reasonable royalty on the '104 patent is [redacted] of gross Android advertising revenues, while the royalty on the copyrights is [redacted] of gross Android advertising revenues and the royalty rate for the '520 patent is [redacted] of Android revenues.

M. Calculation of Past Reasonable Royalty Damages

112. Applying the above royalty rates to the actual US Android revenues results in a damage amount of [redacted] through 2011 for the '104 patent, [redacted] for the '520 patent and [redacted] for the copyrights. See Table 8. In this calculation, I use data from Dr. Cox's Exhibit 3b to estimate actual Android advertising revenues to date. His data appear through August 2011. At trial I would anticipate applying the royalty rates to current to-date US Android revenues. To the degree needed, I would also restrict the royalty base to marked or accused products.

N. Future Royalty

113. This same analysis allows estimation of the appropriate going forward royalty, should infringement be found and an injunction not granted. I disagree with Prof. Cockburn that the going forward royalty rate should be based upon a new hypothetical negotiation as of the time of trial that incorporates lock-in effects. The 2006 negotiation upon which my past royalty analysis is based contemplated a license for the life of patents. Thus, in that agreement Google was in effect paying for the freedom from the cost of lock-in in a subsequent negotiation. Incorporating the lock-in effect into the going forward royalty would deprive Google this benefit for which it has already paid.

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[63] I adopt Prof. Cockburn's approach to value the '520 patent; assuming it has the average value of the [redacted] patents in the 2006 portfolio. Dr. Leonard argues for a higher valuation of the '520 patent, but as I understand his suggestion, it relies on results from Prof. Cockburn's Independence Significance Approach and this part of Prof. Cockburn's report has been determined to be inadmissible.

O. Comparison with the Reasonable Royalty Opinions of Prof. Cockburn and Drs. Leonard and Cox

114. My estimate of past reasonable royalty damages is similar in magnitude to that of Drs. Leonard and Cox. [redacted] However, while Drs. Leonard and Cox also arrive at a similar conclusion based on analysis of the "$100 million" offer, I do not believe their analysis in that instance is useful and the similarity in our conclusions appears to be coincidence.

115. Drs. Leonard and Cox are silent on the appropriate portfolio royalty rate going forward. However, their analyses would imply either a royalty rate of approximately [redacted] per Android handset, or a royalty of approximately [redacted] of Android revenue. These amounts are lower, but in the same ball park, as my estimates. If Drs. Leonard and Cox opined that the going forward royalty were significantly lower than these amounts, I would likely disagree (although of course, I would first consider their rationale).

116. Prof. Cockburn concludes that the likely portfolio royalty payment from Google to Sun for the use through 2011 of all the patents and copyrights under negotiation in 2006 would be [redacted]. He then apportions this amount to the specific patents and copyrights in suit, based on his Group and Value analysis. As discussed herein, I find the Group and Value approach to reliable, albeit with some revisions. However, as I discuss above, I do not agree with the Prof. Cockburn's apportioned total of [redacted] This amount seems far too high, as a payment only for the use-to-date of the 2006 portfolio.

117. To highlight the difference between my approach and both Prof. Cockburn's approach and Dr. Leonard's approach, I note that that my estimate of damages through 2011 or at the 2012 date of trial – which are determined in my approach by multiplying actual Android revenues by a reasonable royalty rate – are modest because the royalty rate is modest and actual Android revenues are modest. A going-forward payment, how-

ever, could be quite different because while the royalty rate is modest, actual or projected post-trial Android revenues could be larger, perhaps very large.

P. Other Copyright Damages

VI.1.1. Disgorgement of Infringer's Profits

118. Oracle claims disgorgement of infringer's profits as one measure of its damages under copyright. As I understand the law, the copyright holder is entitled to recover all profits of the infringer that are due to the infringement, so long as these profits are not otherwise accounted for in other measures of damages awarded to the copyright holder. I understand the copyright holder only need prove total revenues from the infringing products, while the burden is on the infringer to prove costs (thereby reducing revenues to profits) and what portion of the profits if any are due to factors other than the infringement.

119. Prof. Cockburn asserts that Android revenues through the end of 2011 total [redacted] [64] Dr. Cox asserts these revenues total only [redacted] [65] I am not in a position to adjudicate the dispute between Prof. Cockburn and Dr. Cox on Android actual revenues. I presume at the time of trial evidence will be presented on the actual total Android revenues to date. In what follows I adopt the revenue figures of Dr. Cox, but do so for convenience and not as an endorsement of their accuracy.

120. Dr. Cox takes two alternative approaches to reduce total Android revenues to profits. First he deducts total Android costs to date from total Android revenues and concludes that total Android profits to date are negative.[66] This conclusion appears to be correct and is undisputed by Prof. Cockburn. Dr. Cox recognizes, however, that the engineering and development costs of Android are significant, and that these costs are properly char-

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[64] Third Cockburn Report 2/3/2012, exhibit 19.

[65] Cox Exhibit 2a.

[66] Cox Exhibit 2a.

acterized as investments that should be capitalized and depreciated over the expected life of the product. Dr. Cox chooses to amortize these engineering costs over a 5-year period. Prof. Cockburn argues that five years is too short a period over which to amortize these costs, noting that Google typically depreciates intangible assets over 12 years and property and equipment over up to 25 years, and that platform products, like Android require time before turning a profit.[67] While I believe Prof. Cockburn's objection has some merit, I conclude that the five year amortization period used by Dr. Cox is appropriate. As Dr. Cox notes, custom software has an average service life of 5 years.[68] While the expected life of Android certainly exceeds five years, Google continually invests in engineering to develop and release new, upgraded versions of Android. Note for example that Android engineering expenses in 2011 are higher than in any previous year. Thus, while Android may have an expected commercial life of greater than five years, it is not clear that engineering performed in a specific year has an expected life of greater than five years.

121. Dr. Cox also subtracts from total Android revenues the cost to Google of purchasing Android. Dr. Cox does not amortize these costs over any time period. In this respect, Dr. Cox errs. The purchase cost of Android is a one-time fixed cost. This cost should be amortized, and should be amortized over the expected life of Android. I assume the expected life of Android to be 14 years.[69] I amortize the purchase cost of Android (both the [redacted] purchase price and the [redacted] in milestone payments) using the interest rate and formula employed by Dr. Cox. The results are shown in Table 9. Through the end of 2011, Android profits total [redacted]

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67 Cockburn's Reply to Cox dated October 10,2011 paragraphs 24 and 42.

68 Cox Revised Report dated 11/28/11, footnote 111.

69 Android P&L 3-Year Plan Model (GOOGLE-01-00004621.xls) and Cockburn Report 5/20/11 exhibit 19.

122. Both Prof. Cockburn and Dr. Cox appear to interpret the relevant portion of copyright statue to restrict the infringer's profits subject to disgorgement to be, not all profits from the infringing product, but only those profits *due to* the infringing product. It is unclear to me whose burden it is to show which Android revenues or profits are due to the alleged copyright infringement. However, whoever bears this burden has failed to meet it. Prof. Cockburn offers an opinion only on gross Android revenues and does not attempt to determine what portion of these revenues are due to the copyright infringement.[70] Dr. Cox does attempt to apportion total Android revenues between those due to the infringement and those due to other factors. However, his attempt is incorrect and his conclusion unreliable.[71]

123. Dr. Cox opines that [redacted] of Android revenues are due to copyright infringement.[72] The [redacted] figure is based on the lower bound estimate of the value of the patents in suit from Prof. Cockburn's Group and Value analysis, and Prof. Cockburn's opinion that the value of copyrights in suit are approximately one half the value of the patents in suit. Dr. Cox misinterprets the meaning of Prof. Cockburn's [redacted] apportionment percentage. This percentage is the value of the patents in suit as a percent of the total value of all patents in the patent portfolio that was the subject of the 2006 Sun / Google licensing negotiations. Moreover, the patent valuation study upon which Prof. Cockburn relies to derive his [redacted] apportionment percentage appears to base the valuation of the individual patents on a "market value" of the patent.[73] The value of these patents may not closely correlate

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[70] The econometric and conjoint analyses contained in Prof. Cockburn's previous reports might serve as a basis for this apportionment, if they were sufficiently reliable and admissible, although Prof. Cockburn did not propose to use these analyses for that purpose.

[71] The Court recently excluded Dr. Cox's opinions regarding the apportionment of Google's unjust enrichment. As such, my discussion here is likely moot.

[72] Cox Supplemental Expert Report, exhibit 2a

[73] The study, "The Value of European Patents - Evidence from a Survey of European Inventors," Final Report of the PatVal EU Project, uses a self-reported estimate by the inventor of the minimum amount the patent holder would accept to sell the patent. This is an asset value (the amount someone would pay to own the patent) not a licensing value (the amount someone would pay to use a patent).

with the contribution of the patents to incremental Android revenue.[74] Also note that the denominator in Prof. Cockburn's [redacted] copyright apportionment percentage is the value of the total Java mobile patent and copyright portfolio, not the total value (i.e., revenue) of Android. As the Court has noted, the value of Android need not equal or bear any relationship to the value of the Java mobile patent and copyright portfolio. Therefore, I do not believe that the results of Prof. Cockburn's Group and Value analysis can be reliably used by Dr. Cox to estimate the percentage of Android revenue that is due to copyright infringement.

124. Based on the admissible evidence in this matter, I am not aware of a quantitative method to estimate the percent of Android revenue or profit that is due to the alleged copyright infringement. Prof. Cockburn and Drs. Leonard and Cox have marshaled the evidence both for and against the proposition that the use of the Java APIs was important to the success of Android. While I do not have a quantitative estimate to provide the jury, my opinion is this evidence shows the use of the Java APIs was important, but not essential, to the success of Android. Thus, I would not advise the jury to conclude that all Android revenue and profits are due to the alleged copyright infringement, nor would I advise the jury to conclude that none of Android profits are due to infringement.

125. Finally, in his most recent report Dr. Cox also presents an alternative measure of unjust enrichment damages. Dr. Cox observes that Prof. Cockburn opines that [redacted]s sufficient to compensate Oracle for Google's use of the entire portfolio of intellectual property, in the way Google used it (an incompatible open source implementation). Dr. Cox then uses this royalty rate to calculate the entire

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74 For instance, a patent that has broad application may command a very high market (asset) value, but be of only limited value to an individual licensee (because the patent has a limited impact on increasing that licensees revenues). As another example, if use of a patent allowed a reduction in costs, for instance, the patent may be valuable while not contributing to incremental revenue.

value of the portfolio, and employs apportionment percentages from Prof. Cockburn's work to derive the value of the copyrights.[75] Dr. Cox is implicitly assuming that all of the value that Sun would have received under the 2006 license would have been in the form of the 10% royalty. As I discuss above, most of the value to Sun from that license would have been in the opportunity for Sun to offer a commercial version of the operating system (Android). The 10% royalty was in addition to, not in replacement of, this commercialization opportunity. Thus, Dr. Cox's analysis here is incorrect.

VI.1.2. Lost Profits – Java ME

126. Java ME, the micro edition of Java, is designed to write software for devices with limited memory, and is run on some mobile devices. Sun had an established business of licensing Java ME to mobile phone handset OEMs, as well as for use in other devices such as television set top boxes and soda machines. Oracle argues that the infringement by Android of the Java ME copyrights has led a decrease in Java ME licensing revenue.

127. Prof. Cockburn calculates Java ME lost profits from 2009 through 2011. His approach is standard. Using a 2007 Sun strategic forecast of Java ME licensing revenues and data on actual licensing revenues, Prof. Cockburn calculates the amount by which actual Java ME licensing revenues fall short of forecasted revenues. Prof. Cockburn implicitly attributes this entire difference (which he labels "lost revenue") to the copyright infringement by Android. He then calculates the ratio of Cost of Goods Sold to Revenue, and Sales Costs to Revenue, in 2006. [redacted]

[75] Although he does not discuss this approach, presumably Dr. Leonard could use the same method to value the patents.

[76] Third Cockburn Report 2/3/2012, exhibit 20

128. Dr. Cox raises several objections to Prof. Cockburn's analysis and conclusions. These include:

1. Prof. Cockburn uses an incorrect forecast.
2. Prof. Cockburn includes forecasted revenues from non-mobile phone applications.
3. Prof. Cockburn uses an incorrect figure for actual 2011 Java ME revenues.
4. Prof. Cockburn attributes all lost revenues to Android.
5. Prof. Cockburn attributes all lost revenue to the copyright infringement of Android.

129. [redacted]

130. [redacted]

[77] Reply Report of Cockburn to Cox paragraph 54.

[78] Reply Report of Cockburn to Cox, paragraph 57.

131. Prof. Cockburn’s explanation sounds reasonable, although what scenarios the various forecasts represent is ultimately a fact issue on which an economist has no special expertise. For my analysis here, I adopt the “strategic” forecast used by Prof. Cockburn. I would advise the jury that, if the jury believes the “high” forecast better represents the “but-for” prospects for Java ME, as of approximately 2007, then the jury should award damages based on that forecast. I can easily prepare an exhibit that presents my calculations using this forecast and will do so if asked.

132. [redacted]

[redacted]

134. [redacted]. As

[79] Expert Report of Dr. Cox 11/28/2011 page 57.

[80] Cockburn Reply to Cox Exhibit 2

such, I am of the opinion that Java TV and other embedded services should be excluded in the calculation. I also note however that the difference in the actual vs. projected revenues for Java in mobile devices (where actual revenues fall well short of projections) compared to the actual vs. projected revenues for Java in other applications (where actual revenues exceed projections) is economic evidence that the shortfall in Java licensing revenues in mobile devices is due to changes in the mobile device market (such as, perhaps, the emergence of Android) and not due to other issues that would affect all Java ME licensing revenues.

135. Total Java ME revenues in 2011 were not known when Prof. Cockburn prepared his September 2011 report. [redacted].[82] It is my opinion that the damages calculation should utilize the most current and accurate data on actual licensing revenues. As with the issue of actual Google revenue from Android, I am not in a position to adjudicate whose assumption about actual past Java ME licensing revenues is correct. Presumably this is a number that can be known with certainty, and will be known at trial. I will

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[81] Reply Report of Cockburn to Cox paragraph 68.

[82] Expert Report of Dr. Cox 11/28/2011 fn. 216.

use that number in my calculations. For the purposes of this report, I use the revenues assumed by Prof. Cockburn.[83]

136. [redacted]. Dr. Cox uses Strategy Analytics' January 2011 forecasts of global smartphone sales to apportion a part of Java ME's lost revenues to Apple iOS. Dr. Cox only apportions lost revenues to iOS – and not other smartphones – because the iOS (and Apple iPhones) do not use or license Java ME, while most other smartphones (such as Blackberry) do.

137. Prof. Cockburn dismisses Dr. Cox's adjustment with two arguments. [redacted]

138. I do not find Prof. Cockburn's arguments persuasive. [redacted] However, strong growth – especially stronger than expected growth – of one product might cause actual revenues from a substitute product to fall short of projections. The key issue is what did Sun expect regarding iPhone share

[83] Adopting Prof. Cockburn's assumption is not meant as an endorsement of his assumption over the assumption of Dr. Cox. However, these are Oracle revenues, so I adopt the data used by the Oracle expert.

[84] Reply Report of Cockburn to Cox paragraphs 71-72.

and units sold when it prepared its forecast in early 2007. I have not seen any evidence on this point. However, it is my impression that the actual success of the iPhone has been surprising to industry participants, relative to expectations in early 2007.[85] [redacted] Thus, I believe that Dr. Cox's apportionment step to be correct.

139. However, while I agree some apportionment of Java ME lost profits to the iPhone is appropriate, I do not agree with Dr. Cox's formula for doing so. Dr. Cox's apportionment is, I believe, unnecessarily complex and leads to an over-allocation of the Java ME lost profits to the iPhone, and thus an underestimate of damages to Sun. I adopt the straight-forward approach of taking the total lost Java ME profits in each year and allocating these to either the iPhone or Android, based on the proportional market share of these two platforms. Note that this likely overstates the impact of the iPhone to Java ME lost profits, because it allocates Java ME losses to the total iPhone share, not the "unexpected" iPhone share. Thus, it is likely that my damage estimate here is biased downward, and, hence, conservative.

140. Dr. Cox's final criticism of Prof. Cockburn's analysis is that according to Prof. Cockburn's own analysis, only a part of Android's sales can be attributed to the copyright infringement. Dr. Cox argues that absent infringement Android would still have a market share that would be [redacted] of the actual Android market share.[86] This was based on Prof. Cockburn's (and Prof. Shugan's) conjoint analysis. After Prof. Cockburn filed his most recent report (on February 3rd), Dr. Cox revised his calculations to use the [redacted] copyright

[85] http://www.wirelessindustrynews.org/news-aug-2009/1624-081309-win-news.html

[86] Dr. Cox makes a mistake here. He assumes Prof. Cockburn's conjoint analysis showed that, absent copyright infringement, Android market share would decrease by 13.5%. This is incorrect. Prof. Cockburn's conjoint analysis showed that, absent copyright infringement, Android market share would decrease by 19.2%. The 13.5% figure is the net reduction in Android advertising revenues, after considering the mitigating effects whereby Google re-captures some lost advertising revenue from "lost" Android uses when those users conduct Google web searches on other types of phones.

apportionment percentage from Prof. Cockburn's "Group and Value Approach."[87] I understand this revision has been stricken by the court.[88]

141. [redacted] While he does not spell it out clearly, Prof. Cockburn appears to argue that smartphones with a non-infringing Android would still require a license from Sun (Oracle) for Java ME, and thus increased market penetration of a non-infringing Android would not decrease Sun Java ME licensing revenues. This appears to be correct. I understand that most smartphone OEMs license Java ME for use on smartphones that use an operating system other than Android or iOS.[89] Dr. Cox appears to implicitly accept this argument, when he only apportions some of the Java ME lost profits to growth in the iPhone and not to other smartphone models using another operating system.

142. The important economic issue is that Java ME is not a substitute for Android, but rather a complement to a non-infringing Android and an already-incorporated complement in the infringing Android. This is the source of the lost Java ME profits. Increased market share of non-infringing Android does not displace Java ME licensing revenues (since Java ME does not substitute for Android). It is the lack of a need for a Java ME license by

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[87] Dr. Cox also makes an error here. He interprets Prof. Cockburn's copyright apportionment percentage as a measure of the incremental market share of Android due to the use of the disputed Java APIs. This is incorrect. The [redacted] copyright apportionment percentage from the Group and Value approach is an estimate of the value of the copyrights as a percent of the total value of all Java mobile related patents and copyrights. While one might expect that more valuable patents would lead to greater product acceptance in the market, this need not be the case at all, and there certainly does not need to be a tight relationship between the two.

[88] Court Order 3/15/2012 Document 796

[89] http://www.oracle.com/technetwork/java/javame/javamobile/overview/about/index.html

the infringing version of Android that displaces Java ME licensing revenues. This displacement occurs for every unit of the infringing Android, not just the incremental units that are the result of the infringement.[90] As such I agree with Prof. Cockburn that the calculated lost Java ME licensing revenues do not need to be apportioned to reflect the but-for market share of a non-infringing Android.

143. My calculation of Java ME lost profits damages is presented in Table 10. [redacted]

VI.1.3. Lost Profits – Java FX

144. [redacted] As I discuss below, this difference is important in an analysis of Oracle's lost profits claim.

145. [redacted]

146. [redacted]

[90] My assumption that OEMs using the actual (infringing) Android would not need a Java ME license, while OEMs using a non-infringing Android would need a Java ME license, is critical. If OEMs license Java ME for use on the actual (infringing) Android, then my assumption would be incorrect and I would revise my opinion here.

[redacted]

147. [redacted]

148. [redacted]

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91 Expert Report of Ian Cockburn 9/12/2011 Exhibit 21. While Dr. Cox does not raise an objection, I [redacted] .

92 Expert Report of Dr. Cox 11/28/2011 page 55.

93 Expert Report of Dr. Cox, p. 58. As discussed above the [redacted] figure is the incremental Android revenue due to the copyright infringement, not the incremental market share. Dr. Cox should have used the [redacted] incremental market share figure.

[redacted][94]

149. Prof. Cockburn again dismisses all of Dr. Cox's arguments, [redacted]. [redacted]. However, as I understand Oracle's claim, it is not claiming damages from the existence of Android, but from the copyright infringement of Android. Absent copyright infringement, Android could (and likely would) still exist, although it would likely have a somewhat lower market share. [redacted]

150. [redacted]

[94] Supplemental Expert Report of Dr. Cox 2/17/2012 paragraph 44. This apportionment percentage is based on Prof. Cockburn's "Group and Value" method. As discussed above, however, the apportionment percentage from the Group and Value method is not a measure of the incremental market share of Android due to the copyright infringement. Thus, Dr. Cox's use of this percentage here is incorrect.

[95] In the analysis of Java ME lost profits, Prof. Cockburn (and I) assume that absent copyright infringement OEMs using Android would license Java ME from Sun and include Java on their Android handsets. Thus, non-infringing Android phones would be Java compatible.

[redacted]

VII. Analysis of the Georgia-Pacific Factors

151. The seminal case with regard to a reasonable royalty determination in the framework of a hypothetical negotiation is *Georgia-Pacific Corp. v. U.S. Plywood Corp*.[96] *Georgia-Pacific* points to those things that ought to considered in bridging to the hypothetical negotiation from the market and technical environments; information available to, and expectations of, the parties; and negotiations, if any, between the parties or others who are similarly situated at or before the time of infringement.

Factor 1. The royalties received by the patentee for the licensing of the patent in suit, proving or tending to prove an established royalty.

152. It is my understanding that there are no Sun licenses for specific Java ME patents and, hence, no contemporaneous or near contemporaneous licenses for the in suit patents.

153. There are Sun licenses for the Java ME IP portfolio. [redacted]

[96] 318 F. Supp. 1116, 1119-20 (S.D.N.Y. 1970), *modified and aff'd*, 446 F.2d 295 (2d Cir.); approved by the Federal Circuit in *Unisplay, S.A. v. American Electronic Sign Co., Inc.*, 69 F.3d 512, 517 n.7 (Fed. Cir. 1995).

[redacted]

Factor 2. The rates paid by the licensee for the use of other patents comparable to the patent in suit.

154. It is my understanding that there is nothing in the record with regard to Google licensing patents comparable to the in suit patents.

155. Dr. Leonard's Exhibit 3c indicates that [redacted][97] As I understand the matter, this wasn't for use in a full-stack operating system comparable to Android, but it does suggest two things: First, that [redacted]. Dr. Leonard's Exhibit 3c implies that Google had contracted with Sun for a license extending from January 2008 through at least September 2011.[98]

Factor 3. The nature and scope of the license, as exclusive or nonexclusive, or as restricted or non-restricted in terms of territory or with respect to whom the manufactured product may be sold.

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[97] Expert Report of Dr. Gregory D. Leonard, October 24, 2011

[98] Dr. Leonard's Exhibit 3e provides information on HTC, Motorola, and Samsung licenses for Java ME. Curiously, Google's license isn't detailed in this Exhibit although the per unit royalty rate is provided in Exhibit 3c.

156. Proposed agreements drafted during the 2006 negotiations suggest that the license would be non-exclusive, world-wide, perpetual and restricted to Android.[99]

157. While the hypothetical license would allow for an implementation of Sun's Java ME patents and copyrights that were "incompatible", open sourcing Java ME IP was clearly envisioned by both parties and it seems unlikely that a difference in the type of open source license would change whether the license was nonexclusive, perpetual and world-wide.

158. The hypothetical and actual negotiations do differ with regard to incompatibility and possibilities of fragmentation. Sun's February 2006 offer would have been made assuming that Android would have a Java VM and open sourced under the GPL. The hypothetical negotiations would have been for a Dalvik VM and, perhaps, open sourcing under the Apache license. The royalty that I derive from the February 2006 offer (roughly [redacted]) would have accounted for open sourcing, since that was clearly envisioned by both parties in the 2006 negotiations, but it would not have reflected the incompatibilities created by the differences between the Java VM and the Dalvik VM or between the GPL and the Apache open source licenses. This suggests a higher portfolio royalty rate than I have

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[99] While the 2006 negotiations were never consummated, Sun sent a proposed agreement to Google March 16, 2006, to which Andy Rubin responded on behalf of Google on March 26, 2006 and March 29, 2006 (The cover email to the second response indicates that "[e]nclosed is a revised agreement with comments from our attorney." (GOOGLE-12-00044940))

Section 1.17 reads, in part: "Intellectual Property Rights" means all worldwide (a) patents, patent applications, and patent rights; (b) rights associated with works of authorship including copyrights, copyright applications, copyright restrictions . . ." Section 3.1(b) reads, in part: "License to Google of Sun Technology and Tools for Internal Use and Development Purposes. Sun hereby grants to Google a worldwide, nonexclusive, royalty-free (except as provided in Section 15.2) nontransferable license . . . To the extent Sun Technology is incorporated into Google Developed Software as agreed in the Project Plan, Sun hereby grants Google a perpetual right to use . . ." And in Section 3.1(e) it reads, in part, ". . . Sun hereby grants, upon the successful completion of the Project Plan, that Google and Sun may release . . . the Sun Technology specified in the Project Plan under the appropriate Open Source Model" (GOOGLE-12-00044943, GOOGLE-12-00044947, GOOGLE-12-00044948, GOOGLE-12-00044953).

The proposed license prepared by Sun and sent to Google March 16, 2006 contains the same language in Sections 1.1 and 3.1(d) respectively. (GOOGLE-01-00062074; GOOGLE-01-00062079) It differs with regard to the type of open source license – a matter that apparently could not be resolved – in Section 3.1(e), but is otherwise the same. (GOOGLE-01-00062079) estimated and, hence, a higher apportioned reasonable royalty rate for the in suit patents and copyrights than the numbers put forward elsewhere in my report.

159. [redacted]

160. The license envisioned in the hypothetical negotiation differs from either what might have been the license in the 2006 negotiations or the hypothetical negotiation for the 2006 portfolio, deriving the value of a license for a specific patent or subset of patents from a portfolio negotiation ignores the option and/or insurance value associated with a portfolio. As such, an upward adjustment for the value of the option and/or insurance may be warranted. Put differently, this Factor suggests that the royalty rate I have derived is a lower bound for a reasonable royalty.

161. I understand that Oracle can recover damages only for infringement within the U.S. There is no reason to believe that this would affect the royalty rate; it would, however, affect the revenue base to which the royalty rate is applied, which I have limited to Android devices sold within the U.S.

162. Since I have assumed that hypothetical and actual negotiations do not differ with regard to exclusivity, duration or geographic restrictions, no adjustments are warranted with regard to these components.

Factor 4. The licensor's established policy and marketing program to maintain a patent monopoly by not licensing others to use the invention or by granting licenses under special conditions designed to preserve that monopoly.

163. Sun was willing to license Java ME IP and did so, generally with "field of use" restrictions. The 2006 negotiations weren't, in kind, different from Sun's other negotiations

in this regard except, perhaps, for open sourcing what it believed would be a compatible (i.e., Java VM-based) Android. But, as noted in my discussion of G-P Factor #3, its February 2006 offer would have reflected this difference. Hence, beyond the upward adjustments suggested in this earlier discussion, there should not be an adjustment specific to this factor.

164. This opinion differs from Prof. Cockburn's, who suggests that Factor 4 "warrants an upward adjustment of (the) starting point" and Dr. Leonard's, who suggests that Factor 4 "suggests a slightly lower royalty, all else equal."

165. If an appropriate adjustment could be made for incompatibility and possible fragmentation, per Factor 3, then no additional adjustment should be made just because Sun was willing to license its Java ME IP widely. Prof. Cockburn is inappropriately arguing for the same adjustment at least twice (in Factor 3 and Factor 4)[100] and Dr. Leonard is simply ignoring the context within which the actual offer was made – it may be that as a general matter, willingness to license anyone would lead to lower royalty rates but that doesn't mean that there should be an adjustment to a royalty rate that already reflects this fact.

Factor 5. The commercial relationship between the licensor and licensee, such as whether they are competitors in the same territory in the same line of business, or whether they are inventor and promoter.

166. Under the 2006 February offer, Sun and Google would have been collaborators in developing Android, which Sun would have attempted to monetize. Sun also had a viable business licensing Java ME to OEMs for mobile phones, where there may have been competitive pressures from a successful compatible Android. However, Sun's expectations regarding these competitive effects would have been incorporated in its 2006 offer.

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100 In fairness, it's unclear whether Prof. Cockburn believes there should be an adjustment for the matters covered by Factor 3 and then an additional adjustment for the matters covered by Factor 4 or simply reemphasizing the need for a single adjustment based on either Factor 3 or Factor 4.

To the degree that an incompatible Android was a greater competitive threat to Sun's Java ME mobile phone OEM revenues than was a compatible Android, the royalty in the hypothetical negotiation would have been higher than the royalty I have estimated. This would suggest an upward adjustment to the royalty implied by the 2006 negotiation.

167. [redacted] There is no evidence that I know of that suggests that Sun was anticipating a parallel development of its own smartphone operating system at the time it was negotiating with Google in 2006 to collaboratively develop Android. As such, Dr. Leonard's discussion of the reasons for Project Arcadia's failure is beside the point with regard to this Factor.

Factor 6. The effect of selling the patented specialty in promoting sales of other products of the licensee, the existing value of the invention to the licensor as a generator of sales of non-patented items, and the extent of such derivative or convoyed sales.

168. Sun presumably understood in 2006 that Google's interest in providing an open source, Java-VM based Android to the market was tied to its revenues from advertising. Sun could easily have inferred that Google's interest was either to protect its existing revenues from erosion due to competition (e.g., a Microsoft platform with something like what came to be Bing) or to expand its revenues with the growth of search from mobile devices. Had a deal been consummated along the lines of the February 2006 offer, it would have incorporated these expectations. There's little reason to believe that an incompatible, Dalvik VM Android would change Google's expectations or interest in this regard. I conclude that since these expectations are already incorporated in the 2006 actual negotiations, that this Factor warrants no adjustment, up or down in my estimated royalty embedded in the 2006 February offer.

169. Prof. Cockburn argues for an upward adjustment. He notes that *Georgia-Pacific* "contemplates that the portion of such benefits (the value of Google of Android) due to the patents-in-suit should be accounted for in the reasonable royalty. . . [e]conomically, it makes sense to consider and account for all of the benefits that Google would have reasonably anticipated from the infringement in determining what Google would have agreed to pay Sun for a license."[101] I agree, but, assuming that Google actually agreed to Sun's February 2006 offer, these benefits are already reflected in the terms of the agreement.

170. Dr. Leonard argues that putative existence of non-infringing substitutes means that it is "incorrect to attribute to the patents-in-suit any significant amount of revenues. . . (t)his factor suggest a lower royalty. . ."[102] This too is incorrect if one assumes that Sun's February 2006 offer was essentially the "deal" that would have been made. There may have been, and probably were, non-infringing substitutes in 2006, but they too would have been reflected in the terms of the February 2006 "deal".

Factor 7. The duration of the patent and the term of the license.

171. As discussed elsewhere, the royalty rate I derive assumes that a deal based on the February 2006 offer and any contemporaneous hypothetical negotiation would have been for the life of the patents. Since there are no differences between the actual offer and the hypothetical negotiation in this regard, no adjustment is warranted.

Factor 8. The established profitability of the product made under the patent, its commercial success, and its current popularity.

172. Since I have estimated a percentage royalty rate to be applied to Google's actual Android revenues, the amount due Oracle should infringement be found scales automatically with Google's success. No further adjustment, up or down, is necessary or warranted.

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[101] Expert Report of Dr. Iain M. Cockburn 9/15/2011 paragraph 88.

[102] Expert Report of Dr. Gregory K. Leonard 10/24/2011 p. 68.

173. Dr. Leonard finds that this factor is neutral. While this is my opinion as well, his reasoning is different than mine and implies something different than mine as well. Specifically, what he means is that a lump sum royalty determined based on 2006 expectations should not be adjusted for the subsequent success of Android.[103] What I mean, by contrast, is that a royalty rate determined based on 2006 expectations should not be adjusted, but that since this royalty rate would have been applied to actual Android revenues, damages based on my royalty estimate will be greater if Android is more successful and vice versa.

174. Prof. Cockburn argues that Factor 8 supports an upward adjustment in the royalty. I disagree and find his argument a little perplexing. I do not disagree with his observations that in 2006 Sun's Java ME was popular, that its licensing business was profitable, that the Java language was popular and widely used, and that Oracle paid a lot of money when it acquired Sun and Sun's Java IP in 2010. However, these factors are irrelevant to any adjustment warranted for Factor 8 for three reasons: First, the latter is an ex post-to-2006 valuation. Second, this Factor deals with the "product made under the patent", i.e., a Dalvik VM Android. Third, Sun made an offer in February 2006 knowing all of these things (except the amount that Oracle was willing to pay for Sun and Sun's Java IP in 2010), so to the degree that any one or all of them mattered, they were things that would have been reflected in Sun's offer. Elsewhere I have indicated that I believe that an upward adjustment is warranted for incompatibility and possible fragmentation, but there shouldn't be an additional, or independent, adjustment based on Factor 8.

Factor 9. The utility and advantages of the patent property over the old modes or devices, if any, that had been used for working out similar results.

[103] Dr. Leonard argues that Android's revenues would have been the same with and without the in-suit patents. I believe this to be wrong, for reasons discussed elsewhere, including in Factor 6. He also argues that a reasonable royalty should be determined by Google's expectations in 2006. I agree with regard to determining the royalty rate; I disagree in terms of determining damages at the date of trial.

175. There is no serious disagreement that the availability of applications and the speed with which a smartphone boots and its applications loads are important to end users and, hence, to OEMs. Likewise, there isn't disagreement that Google wants Android to be widely used. It follows that to the degree that the in suit patents were expected to enhance speed and the in suit copyrights were expected to make possible more applications, and in particular, more Java-language-based applications sooner than would have otherwise been the case, the in suit patents and copyrights were in 2006, and are in 2012, valuable to Google.

176. A review of the consumer and trade press confirms that end users value speed and they value applications.[104] The Enhanced Econometric Model developed in Appendix F also confirms this observation. As detailed in Appendix F, Section 3(f), an 80% reduction in the *linpack* score reduces the willingness to pay between $8 and $38 with an average of $21 – these amounts represents a reduction in willingness to pay of 6.2% for the respective Android phones. Limiting the number of applications available on the phone between 6,000 and 40,000 results in a reduction in willingness to pay between, on average, $12 and $22. These averages imply percentage changes in willingness to pay of between 2% and 7% with an average of 5%.

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104 Regarding speed, see for instance, Gargi, Neha. "How to Buy a Cellphone (Smartphone) Running Android OS." Cell Phone Beat. http://www.cellphonebeat.com/buy-cellphone-smartphone-running-android-os.html; Rahimi, David. "How Important Are Specs In A Smartphone?" Cell Phone News, Reviews, and How Tos. Phone Buff, 21 Jan. 2012. http://www.phonebuff.com/2012/01/important-specs-smartphone/; Gordon, Whitson. "How to Pick Your Next Android Phone: The Specs That Matter (and the Ones That Don't)." Lifehacker, Tips and Downloads for Getting Things Done. 19 Jan. 2011. http://lifehacker.com/5737659/how-to-pick-your-next-android-phone-the-specs-that-matter-and-the-ones-that-dont; Mies, Ginny. "The Phone Specs That Matter." Reviews and News on Tech Products, Software and Downloads. PC World, 10 June 2011. http://www.pcworld.com/article/230109/the_phone_specs_that_matter.html.

Regarding the number of available applications, see "Mplayit Analysis Shows IPhone Losing Its Edge in Apps." Mplayit, 13 Jan. 2010. http://www.prnewswire.com/news-releases/mplayit-analysis-shows-iphone-losing-its-edge-in-apps-81311677.html; Appsfire Team. "APPtrition – or Why App Store Size Does Not Matter That Much…."Appsfire On App Discovery. 8 June 2011. http://blog.appsfire.com/56242179/; Grothaus, Michael. "Android Market Could Surpass App Store in Size This Year, Research Suggests." TUAW Beta. 5 May 2011. http://www.tuaw.com/2011/05/05/android-market-could-surpass-app-store-in-size-this-year-resear/; Wauters, Robin. "Android To Surpass Apple's App Store In Size By August 2011: Report (Exclusive)." Tech Crunch. 5 May 2011. http://techcrunch.com/2011/05/05/android-to-surpass-apples-app-store-in-size-in-august-2011-report-exclusive/.

177. Dr. Leonard suggests that in 2006, Google could have used a Java language compiler in Android in lieu of the Dalvik VM. As I understand the matter, he is arguing that Android could have forfeited the benefits of a virtual machine without much cost. He also argues that Google could have readily used another programming language instead of Java, again without much cost. Finally, he argues that Google could have replaced the in suit patents, presumably within the Dalvik VM and the copyrights without much cost. Whether any of this could have been done technically is certainly beyond my expertise and, I suspect, his, Dr. Cox's and Prof. Cockburn's as well. With regard to cost, the issue really is the opportunity cost in terms of what Google would have lost with an Android without the benefits of a virtual machine and an Android that could not be as easily marketed to OEMs and developers who were interested in platforms where the Java language could be used.

178. There is some indirect evidence of Google's opportunity costs. As noted elsewhere, Google was negotiating with Sun for a license to Java ME IP. It did so knowing all of the "non-infringing" options Ds. Leonard and Cox cite. That there was serious discussion for a license that would have required Google to pay Sun tens of millions of dollars and given Sun the opportunity to try to monetize Android is evidence that the alternatives suggested by Drs. Leonard and Cox were not low opportunity cost options. In addition, when the negotiations broke down in 2006, Google *did not pursue any* of these options, but instead pushed forward with a Java-based product and Android *does* have a virtual machine and *was* designed to appeal to Java-language programmers.

179. Based on this "revealed preference" evidence, the royalty rate derived from the February 2006 offer is a reasonable estimate of the lower bound of the marginal benefit to

Google of Sun's Java ME IP portfolio given the (opportunity) cost of all non-infringing substitutes available to Google in 2006.[105]

Factor 10. The nature of the patented invention, the character of the commercial embodiment of it as owned and produced by the licensor, and the benefits to those who have used the invention.

180. As noted in my discussion of Factors 6 and 9, the evidence suggests that consumers value the functionality enabled by the in suit patents and copyrights – assuming, of course, that there is a technical nexus between the in suit patents and copyrights and the speed and applications available to consumers. And, again as noted in Factor 9, the negotiations between Google and Sun, per se, suggest that Google expected that Sun's Java ME IP would provide direct benefits to users of Android and indirect benefits to Google. However, these expectations were known at the time of the 2006 negotiations. Therefore, this Factor does not warrant any adjustment to the royalty rate derived from those negotiations.

Factor 11. The extent to which the infringer has made use of the invention and any evidence probative of the value of that use.

181. See discussion of Factors 9 and 10.

Factor 12. The portion of the profit or of the selling price that may be customary in the particular business or in comparable businesses to allow for the use of the invention or analogous inventions.

182. I know of no evidence in the record available to me that would be useful in addressing this Factor.

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[105] Dr. Leonard's opinion that this factor suggests a "lower royalty" is puzzling. Surely it cannot be the case that in 2006 Google believed that it was negotiating for something that would reduce the value of the smartphone operating system it intended to build. See page 70 of Expert Report of Dr. Gregory K. Leonard 10/24/2011.

Factor 13. The portion of the realizable profit that should be credited to the invention as distinguished from non-patented elements, the manufacturing process, business risks, or significant features or improvements added by the infringer.

183. As I have discussed above, with regard to the Java ME IP portfolio, the 2006 negotiations themselves provide the evidence: Google would not have been willing to enter into negotiations with Sun for Java ME IP if it did not believe (in 2006) that the use of Java ME IP would increase its revenues from the use of Android and the license amount, and the royalty rate that I derive from the February 2006 offer, is itself a best estimate of Google's willingness to pay for the in suit patents and copyrights.

Factor 14. The opinion testimony of qualified experts.

Factor 15. The amount that a licensor (such as the patentee) and a licensee (such as the infringer) would have agreed upon at the time the infringement began if both had been reasonably and voluntarily trying to reach an agreement, that is, the amount which a prudent licensee – who desired, as a business proposition, to obtain a license to manufacture and sell a particular article embodying the patented invention—would have been willing to pay as a royalty and yet be able to make a reasonable profit; which amount would have been acceptable to a prudent patentee who was willing to grant a license.

Respectfully submitted this 21st day of March, 2012.

James R. Kearl

Appendix A: Curriculum Vita

J.R. Kearl

Senior Consultant

Post Doctoral Economics and Law
Harvard University

PhD Economics
Massachusetts Institute of Technology

BA Mathematics and Economics
Utah State University

Dr. J.R. Kearl is a senior consultant to CRA with the Antitrust & Competition Economics Practice and the A.O. Smoot Professor of Economics at Brigham Young University. He specializes in applied microeconomics, industrial organization, and public policy. His areas of expertise include public policy analysis, the economics of antitrust, regulation, intellectual property, economic damages, and trade policy. While a White House fellow, he served as a special assistant to the secretary of defense and to the US trade representative. He has also served on the US Census Advisory Committee on Population Statistics.

Professional experience

2000–Present	*Senior Consultant*, Charles River Associates
1996–Present	*A.O. Smoot Professor of Economics*, Brigham Young University
1991–Present	*Assistant to the President for the Jerusalem Center for Near Eastern Studies*, Brigham Young University
1996–2000	*Director and Senior Economist,* LECG, Inc.
1993–1996	*Chair, University Strategic Planning Initiative and Reaccreditation Self-Study,* Brigham Young University
1989–1991	*Associate Academic Vice President*, Brigham Young University
1986–1997	*Professor, Economics,* Brigham Young University
1986–1989	*Dean of General and Honors Education,* Brigham Young University
1984–1986	*Professor, Economics and Law,* Brigham Young University
1984	*Special Assistant*, United States Trade Representative
1983–1984	*Special Assistant*, US Secretary of Defense
1981–1983	*Chair*, University Library Council
1979–1991	*Research Associate*, National Bureau of Economic Research
1979–1982	*Member*, University Graduate Council
1978–1983	*Associate Professor, Economics and Law*, Brigham Young University
1975–1978	*Assistant Professor, Economics*, Brigham Young University

1973–1974	*Teaching Fellow*, Harvard University
1973	*Visiting Instructor*, Brigham Young University (Summer)
1971–1974	*Research Assistant*, National Bureau of Economic Research
1970–1971	*Teaching Assistant*, Utah State University

Community service

Chair, Food and Care Coalition Board, 2005–2007

Member, Food and Care Coalition Executive Committee, 2003–Present

Member, Food and Care Coalition Board, 2002–2003

Member, Ouelessebougou/Utah Alliance Executive Committee, 2001

Member, Ouelessebougou/Utah Alliance Board, 1997–2000

Member, US Census Advisory Committee on Population Statistics, 1991–1994

Member, Governor's Task Force for Education and Economic Development, 1989

Member, State of Utah Task Force on Concurrent Enrollment, 1988

Honors and fellowships

A.O. Smoot Professorship in Economics, 1996–Present

Maeser Distinguished Teaching Award, 1992

White House Fellow, 1983–1984

Liberal Arts Fellow in Law and Economics, Harvard University, 1977–1978

Fellow, Legal Institute for Economists, 1977

SSRC Postdoctoral Award, 1975

Danforth Graduate Fellow, 1971–1975

BA, magna cum laude, 1971

Elected Blue Key, 1970

Elected Phi Kappa Phi, 1970

First Security Foundation Scholarship, 1970

Publications

Books

Economics and Public Policy: An Analytical Approach, 6th Edition (Pearson, 2010).

Principles of Economics (Simon and Schuster, 1998).

Principles of Economics (DC Heath, 1993).

Principles of Microeconomics (DC Heath, 1993).

Principles of Macroeconomics (DC Heath, 1993).

Contemporary Economics: Markets and Public Policy (Scott Foresman, 1989).

Chapters in books

"Aggregate Production Functions." With F. Fisher and R. M. Solow, *Aggregation: Aggregate Production Functions and Related Topics* (MIT Press), 1993 (reprint of journal article).

"Choices, Rents and the Economic Mobility of Households," With C. Pope, *NBER Studies in Income and Wealth* (University of Chicago Press, 1986).

Journal articles

"The Economics and Curious Law of Prejudgment Interest," With M. Glick and C. Sinclair, *University of Utah Law Review,* forthcoming

"Is There a Consensus Among Economists in the 1990s?" With R. Alston and M. Vaughan. *American Economic Review*, May 1992.

"The Covariance Structure of Earnings and Income, Compensation Behavior, and On-the-Job Investment." *Review of Economics and Statistics*, May 1988.

"Economics and Antitrust Litigation." With S. Wood. *The American Journal of Comparative Law,* 34, Summer 1986.

"Unobservable Family and Individual Contributions to the Distributions of Income and Wealth." With C. Pope. *Journal of Labor Economics*, July 1986.

"Mobility and Distribution." With C. Pope. *Review of Economics and Statistics*, 1984.

"Rules, Rule Intermediaries and the Complexity and Stability of Regulation." *Journal of Public Economics*, 1984.

"The Life Cycle in Economic History." With C. Pope. *Journal of Economic History*, March 1983.

"Wealth Mobility: The Missing Element." With C. Pope. *Journal of Interdisciplinary History*, March 1983.

"Deposit Rate Ceiling De-Regulation and Mortgage Innovation." *Empirical Economics*, Vol. 5, 1980.

"Household Wealth in Utah: 1850–1870." With C. Pope and L. Wimmer. *Journal of Economic History*, September 1980.

"Piecemeal De-Regulation: The Problems of Deposit Interest Rate Regulation and Mortgage Innovation." *Journal of Economics and Business*, Fall 1980.

"Inflation, Mortgages and Housing." *Journal of Political Economy*, September 1979.

"A Confusion of Economists?" With C. Pope, G. Whiting, and L. Wimmer. *American Economic Review*, May 1979. Reprinted in the *Kindai Keizagaku Series*, October 1979.

"Mortgages and Housing: The Issues and Some Evidence." *Journal of Consumer Credit Management*, Spring 1979.

"Inflation and Relative Price Distortions: The Case of Housing." *The Review of Economics and Statistics*, November 1978.

"Legal Impediments to Mortgage Innovation." With M. Hyer. *Real Estate Law Review*, Winter 1978.

"Illiquidity, the Demand for Residential Housing and Monetary Policy." With F. Mishkin. *Journal of Finance*, December 1977.

"The Housing Market and Alternative Mortgage Instruments." In Kaplan (ed.), *Alternative Mortgage Instruments*, Vol. III, D., (Washington, DC: FHLBB, Nov. 1977).

"Do Entitlements Imply that Taxation is Theft?" *Philosophy and Public Affairs*, Fall 1977.

"Aggregate Production Functions: Some CES Experiments." With F. Fisher and R. Solow. *Review of Economic Studies*, June 1977.

"Macroeconomic Simulations of Alternative Mortgage Instruments." With D. Jaffee. In F. Modigliani (ed.), *New Mortgage Designs for Stable Housing in an Inflationary Environment* (Boston, Mass.: Federal Reserve Bank of Boston, Conference Series No. 14, 1976).

"Financial Determinants of Housing Demand." With C. Swan and K. Rosen. In F. Modigliani, (ed.), *New Mortgage Designs for Stable Housing in an Inflationary Environment* (Boston, Mass.: Federal Reserve Bank of Boston, Conference Series No. 14, 1976).

Other publications

Workbook to accompany *Economics and Public Policy: An Analytical Approach*,2003.

"Is Microsoft Above the (Antitrust) Law?" *Utah Bar Association Journal*, September 1998.

Principles of Economics: Instructor's Guide, 1993.

Editor, *A Freshman's Guide to the University,* 1991.

A Parents' Guide to the University, 1991.

Contemporary Economics: Instructor's Guide, 1989.

Co-Editor, July 1986 special issue of *The Journal of Labor Economics.*

"The Family and the Distribution of Economic Rewards: An Introduction." *The Journal of Labor Economics*, July 1986.

"Protectionism: The Myths." *BYU TODAY*, 40, No. 2, pp. 24–37, April 1986.

"Comments." *Symposium on Countercyclical Stimulus Proposals for Single Family Housing* (Washington, DC: GAO, 1982).

"Inflation and the Price of Housing: Comment." *House Prices and Inflation*, (Washington, DC: The Urban Institute, June 1982).

Index to the 1850, 1860 & 1870 Censuses of Utah. With C. Pope and L. Wimmer. (Baltimore: Genealogical Publishing, Inc., 1981).

"A Dialogue on 'The Market' Economy," *Century 2*. BYU, Fall 1980.

"Freedom, Economic Efficiency, and Equality." With C. Pope. In L. Tullis (ed.), *Mormonism: A Faith For All Cultures*, (Provo, Utah: BYU Press, 1978).

"Econometric Forecasting—The Dismal Science Redux?" *Intermountain Economic Review*, Spring 1977.

"Capitalism and Freedom—A (Critical) Reader's Guide." *Monday Magazine*, Brigham Young University, February 1976.

Professional activities

Presentations at professional meetings and workshops

"Antitrust Law and the Economics of Bundled Prices," Utah Bar Association and CLE Workshop, San Diego, July 2011 (with G. Adams)

"Antitrust Law and the Economics of Aftermarket Monopolization," Utah Bar Association and CLE Workshop, San Diego, July 2011 (with G. Adams)

"Working with Damages Experts in Light of Recent Changes in the Federal Rules," CLE Workshop, Provo, August 2011

"Expert Depositions," Utah Bar Association, Salt Lake City, November 2010.

"Working with Economic Expert Witnesses," CLE Workshop, Provo, August 2009.

"The Economic Approach to Law," CLE Workshop, Provo, August 2008.

"Valuing IP: An Economic Perspective," CLE Workshop, San Diego, January 2004.

"Valuing IP: An Economic Perspective," CLE Workshop, Seattle, July 2003.

"Causality and Damages: An Economic Perspective," CLE Workshop, Phoenix, March 2003.

"Switching, Adding, or Shifting: Network Effects, Compatibility and Lock-In," 8th International Conference of The Society for Computational Economics, July 2002.

"Shifting, Adding, Replacing: Network Effects and Market Behavior," World Congress of Network Economics, Aix en Provence, July 2002.

"IP Damages and Markets," CLE Workshop, San Francisco, 2002.

"A Skeptical Look at the Use of Network Effects Arguments in Antitrust Litigation," Charles River Associates Conference on New Directions in Antitrust, April 2001.

"Prejudgment Interest and Post-Event Information." Utah Bar Association Meetings, July 1999.

"Microsoft and the Antitrust Laws." Utah Bar Association Meetings, July 1998.

"Partnerships and Incentives." American Economic Association Meetings, January 1995.

"Cohort Effects and Consensus Among Economists." Western Economic Association Meetings,
July 1992.

"Is There a Consensus Among Economists in the 1990s?" American Economic Association Meetings, January 1992.

"Do Individuals Dissave as They Age?" World Congress of the Econometric Society, August 1990.

"The Use of Economic Evidence in Antitrust Litigation." The International Academy of Comparative Law (12th Congress), August 1986.

"The Covariance Structure of Income." WEA Meetings, July 1986.

"The Covariance Structure of Income." Econometric Society Meetings, June 1986.

"The Covariance Structure of Earnings and Income." World Congress of the Econometric Society, August 1985.

"Unobservable Individual and Family Effects." Public Choice Society Meetings, February 1985.

"Unobservable Family and Individual Contributions to the Distributions of Income and Wealth." Conference on the Family and the Distribution of Economic Rewards, 1984.

"Economic Mobility," NBER Conference on Income and Wealth, March 1984.

"Economic Mobility." NBER Working Conference, January 1983.

"Historical Aspects of Life-Cycle Behavior." Economic History Association Meetings, September 1982.

"Life-Cycles in Income and Wealth." WEA Meetings, July 1982.

"Life-Cycles in Income and Wealth." Econometric Society Meetings, June 1982.

“Rules, Rule Intermediaries and the Complexity and Stability of Regulation.” Public Choice Society Meetings, March 1982.

“Choice Elements in the Distribution of Wealth.” Econometric Society Meetings, December 1981.

“Choice and Ricardian Elements in the Distribution of Wealth,” “Dollar Auctions and Rent-Seeking Activity,” and “The Economic Structure of a 19th-Century Economy.” Invited paper WEA Meetings, July 1981.

“Panel Data and Historical and Contemporary Issues in the Distribution and Acquisition of Economic Rewards.” Utah Academy of Science, Arts and Letters, Plenary Session, April 1981.

“Intergenerational Effects on the Distribution of Income and Wealth.” IUSSP Conference, April 1981.

“Choice and Ricardian Elements in the Distribution of Wealth.” Public Choice Society Meetings, March 1981.

“Wealth Distribution and Economic Mobility.” Social History Meetings, November 1980.

“Full Employment Output in a Model with Transactions Costs.” World Conference of Econometric Society, August 1980.

“Long Run Output in a Model with Transactions Costs.” WEA Meetings, June 1979.

“Household Wealth in a Settlement Economy.” WSSA Meetings, May 1979.

“Wealth in Nineteenth Century Utah: Determinants and Distribution.” Organization of American Historians, April 1979.

“Household Wealth in a Settlement Economy.” Economic History Workshop, Harvard University, February 1979.

“Innovations in the Mortgage Contract.” American Finance Association Meetings, August 1978.

“A Confusion of Economists?” American Economic Association Meetings, August 1978.

“Wealth in Utah, 1850–1870.” Economic History Workshop, University of Chicago, February 1978.

“Inflation and Housing.” SSRC—FED Research Conference, June 1977.

“Wealth in Utah, 1850–1870.” WSSA Meetings, April 1977.

“Illiquidity, the Demand for Residential Housing and Monetary Policy.” Federal Reserve Bank of St. Louis, Research Workshop, June 1976.

“Inflation and Relative Price Distortions.” WEA Meetings, June 1976.

“Financial Determinants of Housing Demand,” “Macroeconomic Simulations of Mortgage Innovations.” HUD-FHLBB-FED Conference on Mortgage Innovation, January 1975.

Other participation at professional meetings

Discussant, "The State," Liberty Fund Conference, June 1986.

Discussant, Public Choice Society, February 1985.

Discussant, "Constitutionalism and Rights," BYU, January 1985.

Discussant, Liberty Fund Conference on "Art and the State," June 1983.

Discussant, WEA Meetings, July 1982.

Discussant, OMB Conference on Housing, July 1982.

Discussant, WEA Meetings, July 1981.

Discussant, Liberty Fund Conference on "Constitutional Constraints," June 1981.

Discussant, Liberty Fund Conference on "Takings and a Theory of the State," June 1980.

Discussant, Urban Institute Conference on "Housing Price Inflation," April 1980.

Fellow, Legal Institute for Economists, University of Miami Law Center, June 1977.

Discussant, WEA Meetings, June 1976.

Lectureships

Presenter, Seminar on Teaching Large Section Classes, Brigham Young University, 2007.

Presenter, Seminar on Large Section Classes, Brigham Young University, June 2003.

Faculty Member, Land Reform Institute, Republic of China, 1997.

Faculty Member, Professional Development Center, MOEA, Republic of China, 1987–1992.

USIA Lectureship on Economics (Malaysia, Thailand, Indonesia, Philippines), June 1991.

USIA Lectureship on Economics (Hong Kong), June 1990.

USIA Lectureship on Economics (Austria, Switzerland, East Berlin, France), December 1988.

USIA Lectureship on Economics (Nepal, India), June 1988.

USIA Lectureship on Economics (Hong Kong, Pakistan), June 1987.

USIA Lectureship on Economics (Korea, Thailand, Japan, Taiwan), June 1986.

Presenter, GE Seminar on Undergraduate Education, June 1986.

USIA Lectureship on Economics (Germany, Italy), December 1984.

Presenter, Seminar on Defense Organization and Budgeting, 1983–1984.

Presenter, Seminar on Economic Journalism, July 1977.

Presenter, Seminar on Real Estate Finance, USU, December 1976.

Presenter, Seminar on Applied Econometrics, SIU, June 1976.

Consulting—research grants

Consultant, ETS, 1986–1987.

J. Fish and Lillian F. Smith Family Conference Grant, 1984.

National Science Foundation Grant SES-8218799, May 1983–October 1985.

Consultant, OMB, 1982.

Research Associate, National Bureau of Economic Research, 1981–1991.

Consultant, The Urban Institute, Mortgage Design Project, 1980.

Principal Investigator, Impacts of Retroactive Regulation, (ACUS), 1979–1980.

Principal Investigator, AMIR's Project (FHLBB), 1977–1978.

Consultant, Scale and Cost in Buildings, The Church of Jesus Christ of Latter-Day Saints, 1977.

Principal Investigator, Mortgage Innovation Study, (HUD), 1975–1977.

Consultant, Optimal Control Project, (NBER), 1975.

Consultant, US Department of Labor, 1975.

Consultant, FHLBB on Variable Rate Mortgages, 1975.

Research Associate, MIT Mortgage Study Group, 1974–1975.

HUD-FHLBB Research Grant, 1974–1975.

Consultant and Bibliographer, Xerox, *XIP Readings in Economics*, 1972–1974.

Research Assistant, NBER Project on Capital Aggregation, 1971–1974.

Consultant, FCC Licensing Petition, 1972.

Reviews

Referee

The American Economic Review, 1981, 1982, 1992, 2002, 2003, 2005.

Journal of Law and Economics, 2004.

Review of Economics and Statistics, 1978, 1979, 1980, 1981, 1982, 1983, 1987, 1989.

Journal of Human Resources, 1989.

AREUEA Journal, 1985, 1987.

Journal of Public Economics, 1981.

National Science Foundation, 1980, 1984, 1986, 1987, 1991.

International Economic Review, 1982, 1987.

Southern Economic Journal, 1980, 1984, 1985.

The Review of Economic Studies, 1980.

Quarterly Journal of Economics, 1980.

Management Science, 1979.

Journal of Economic Dynamics and Control, 1978.

Journal of Money, Credit and Banking, 1978.

Econometrica, 1978.

Manuscript review

Prentice Hall, 1997.

Scott-Foresman, 1983.

West, 1983.

McGraw-Hill, 1982, 1983, 1984.

Addison-Wesley, 1981.

Wiley-Hamilton, 1977.

Cummings, 1975.

Legal work

Economic expert

Rule 706 patent and copyright damages expert, software, 2011–Present

Gaming devices patent damages analysis, 2011–Present

Condemnation damages analysis, construction supply industry, 2010

Arbitration damages analysis in re auction rate securities, 2010–Present

Non-compete contract and tortuous interference damages analysis, construction industry, 2010–Present

Patent damages, retail computer products, 2010–2011

Aftermarket antitrust liability and damages, 2010

Delayed payment of insurance damages issues, 2010

Antitrust claims by medical supply Group Purchasing Organizations, 2009–2010

Real estate contract damages issues, 2009–2010

Dialysis clinic antitrust liability and damages issues, 2009–2010

Online auction damages analysis, 2008–2010

Software market compensation and valuation issues, 2007–2009

Software implementation contract damages issues, 2008–2009

Credit card market antitrust damages issues, 2008

Medical devices antitrust and contract damages issues, 2007–2008

Software IP and contract damages issues, 2007

Hospital merger issues, 2007–2008

Hardware contract damages issues, 2006–2007

Leisure services (golf) antitrust liability and damages issues, 2007

Water distribution antitrust liability and damages issues, 2007–Present

Dental products IP and contract damages issues, 2006–2007

Gaming devices antitrust liability and damages issues, 2006–2008

Molybdenum antitrust liability and damages issues, 2006–2007

Financial market fraud and misrepresentation issues, 2007

Insurance market unfair competition and contract damages issues, 2006–2008

Software product IP and antitrust issues, 2006–2007

Snowmobile IP liability and damages issues, 2006

Truck stop antitrust issues, 2006–2009

Coal fines processing IP damages issues, 2005

Care facility valuation issues, 2005

Pharmaceutical/health care products patent and tort issues, 2005

Auto parts RP matter, 2005–2006

Methods and device patent issues in potato sprout inhibitors, 2002–2004

Trucking credit card contract (settlement) issues, 2004

Health care facilities, providers and insurance competition issues, 2005

Personal services contract damages issues, 2003–2004

Health care facilities antitrust issues, 2005–Present

Medical waste disposal antitrust issues, 2002–2006

Computer security software patent issues, 2004–2005

Computer operating system patent, copyright and contract issues, 2003–2005

Telecommunications switch antitrust and contract issues, 2004

Managed care physician panel antitrust issues, 2003–2005

Sulfur contracting antitrust issues, 2003–2004

Futures markets antitrust issues, 2003

Software patent infringement damages issues, 2003–Present

Radio advertising antitrust issues, 2002–2004

Dialysis clinic contract and antitrust issues, 2002–2003

Coal processing patent infringement damages issues, 2002-2005

Hospital antitrust damages issues, 2001–2005

Software contract damages issues, 2001–Present

Engineering software antitrust issues, 2000–2002

Cellular telephone antitrust issues, 2001–2002

Newspaper mismanagement damages analysis, 2002–2004

Employee class action, credit card business, 2000

Consulting services contract issues, 2000

Physician services and defamation damages issues, 2000

Hospital antitrust issues, 2000

Medical devices patent infringement and reasonable royalty issues, 2000–2001

Explosives merger, 2000

Chemical products antitrust issues, 2000

Propane market antitrust issues, 2000

Retail gasoline market fair trade issues (Idaho), 2000

Grocery distribution antitrust issues, 2000

Trade show market antitrust issues, 2000–2003

Taxation of intellectual property issues, 1999–2000

Construction supply damage issues, 1999–2000

Bank merger antitrust issues, 1999–2000

Construction supply non-compete damage issues, 1999–2000

Health supplement trade dress infringement issues, 1999–2000

Lightning protection market antitrust issues, 1999–2003

Phosphate market antitrust issues, 1998–2000

Products liability damages issues, 1998

Retail floral market antitrust issues, 1998

High-end women's fashions antitrust issues, 1998–1999

Book distribution antitrust issues, 1998

Medical devices patent infringement issues, 1998

Aquaculture feed production patent infringement issues, 1998

Trucking credit card antitrust issues, 1998–2001

Valuation of wastewater collector and treatment facilities, 1997

Chemical market antitrust and contract issues, 1996–1997

Computer software market antitrust issues, 1996–2000

EPA regulation of municipal waste combustors and Clean Air Act issues, 1995–1996

Explosives market class actions and antitrust issues, 1995–1999

Computer software market contract and antitrust issues, 1995–2001

Computer software market antitrust issues, 1995–1996

Foam insulation market antitrust and contract issues, 1990–1995

Retail gasoline market antitrust issues (Utah), 1993–1994

Retail gasoline market antitrust issues (nationwide), 1993–1994

Credit card antitrust issues, 1991–1994

Retail grocery market antitrust issues, 1990–1991

Retail gasoline/diesel market antitrust issues (Utah), 1990–1991

Courses taught

Principles of Economics

Principles of Economics, Honors

Principles of Economics, Independent Study

Economic Principles and Public Policy

Applied Introductory Microeconomics

Applied Microeconomics

Advanced Applied Microeconomics

Applied Econometrics

Applied Welfare Economics

Law and Economics (Economics Students)

Law and Economics (Law Students)

Economics of Antitrust Law and Regulation

International Trade Theory

International Trade Policy

Seminar on Distribution and Mobility

Seminar on Applied Microeconomics

Joint or team taught courses

Seminar on the Economics of Family (with C. Pope)

Honors Colloquium: Modeling Human Behavior (with S. Condie, H. Miller, M. Myers)

Antitrust Law (with R. Lee, then D. Floyd)

Administrative Law (with S. Wood)

International Trade Law (with S. Wood)

Seminar on the History of Jerusalem (with K. Belnap)

Appendix B: Past Testimony

Sears v. Visa

United States District Court; District of Utah, Central Division
Case No. 2: 91CV 47B
Client: Sears
Deposition 1992, Trial Testimony 1992

Utah Foam Company v. The Upjohn Company

United States District Court; District of Utah, Central Division
Case No. C87-955G
Client: The Upjohn Company
Deposition 1995, Trial Testimony 1996

Novell v. NTC

United States District Court; District of Utah, Central Division
Case No. 95CV 523G
Client: Novell
Deposition 1997

Lantec, Inc., a Utah corporation, et al.; Lancompany Informatica LTDA., a Brazil corporation; Lantec Informatica LTDA., a Brazil corporation; Lantraining Informatica LTDA., a Brazil corporation v. Novell, Inc., a Delaware corporation

United States District Court; District of Utah, Central Division
Case No. 95 C 97 S
Client: Novell, Inc.
Deposition 1998

Caldera, Inc. v. Microsoft, Inc.
United States District Court; District of Utah, Central Division
Case No. 2:96CV 0645B
Client: Caldera, Inc.
Deposition 1999

Simon S. Goe and Ocean Star International Inc. v. Sanders Brine Shrimp et al.
United States District Court; District of Utah, Northern Division
Case No. CV0065B
Client: Sanders Brine Shrimp, et al.
Deposition 1998

L.A. Roses, Al Nachom v. Lucky Stores Inc., Larry Cox, and DOES 1 through 100, inclusive
Superior Court of the State of California, Orange County
Case No. 775728
Client: Lucky Stores Inc., et al.
Deposition 1998

Helen's of Course Corp., a Washington corporation; Helen's of Beaverton, Inc., a Washington corporation; and Helen's, Inc., an Oregon corporation v. Escada (USA), Incorporated, a Delaware corporation; and Escada AG, a Foreign corporation
United States District Court; Western District of Washington, Seattle
Case No. C98-0489Z
Client: Helen's Of Course Corp., et al.
Deposition 1999

Heary Bros. Lightning Protection Co., Inc., Lightning Preventor of America, Inc., and National Lightning Protection Corporation v. National Fire Protection Association, Inc., Lightning Protection Inst., Allan P. Steffes, Thompson Lightning Protection Co. Inc., and East Coast Lightning Equipment, Inc.

United States District Court; District of Arizona
Case No. CIV 96-2796 PHX/ROS
Client: National Fire Protection Association, Inc, et al.
Deposition 1999

Transwest, Inc. v. Mark Larsen and Wholesale Metal Products, II, Inc. fka Wholesale Metal Products, Inc. and Mark Larsen, Third Party Plaintiff v. Shawn Reeves, Third Party Defendant

Fourth Judicial District Court; Utah County, State of Utah
Case No. 9804003728
Client: Mark Larsen and Wholesale Metal Products, II, Inc., et al.
Deposition 2000, Trial Testimony 2000

LANCO v. Director, Division of Taxation

Tax Court of New Jersey
Docket No. 005329-1997
Client: Director, Division of Taxation
Deposition 2000, Trial Testimony 2000

Nevada Independent Service Contractors Association ("NISCA"), CB Display Service Inc., Czarnowski Exhibit Service Specialists, Exhibit Installations Inc., Nth Degree Inc., Renaissance Management Inc., Sho-Aids Inc., Zenith Labornet Inc. v. Pack Expo West, Packaging Machinery Manufacturers Institute Inc. (PMMI); World Gaming Congress and Expo; California Grocers Convention Management Group; Bonnie E. Kilduff, Director of Expositions, Packaging Machinery Manufacturers Institute Inc (PMMI); Freeman Companies; Greyhound Exposition Services Inc. ("GES"); Specialty Equipment Manufacturers Association ("SEMA"); Epic Enterprises; United Brotherhood of Teamsters Union, Local 631

United States District Court, District of Nevada
Case No. CV-S-97-01492-LDG (JBR)
Client: Greyhound Exposition Services, Inc.
Deposition 2000, Trial Testimony 2003

Michael Jensen, M.D. v. Mary Sawyers and United Television, Inc., a.k.a. KTVX

Fourth Judicial District Court of Utah County, State of Utah
Case No. 970400512CV
Client: KTVX
Deposition 2000, Trial Testimony 2000

Flying J, Inc., a Utah corporation; TCH, Inc., a Utah corporation v. Comdata Network, Inc., a Maryland corporation; Trendar Corporation, a Tennessee Corporation and DOES 1 through 10

United States District Court, District of Utah, Northern Division
Case No. 1:96CV0066K
Client: Comdata
Deposition 2001

U.S. West NewVector Group, a Delaware corporation v. Cellexis International, Inc., an Arizona corporation; and Cellexis International, Inc., an Arizona corporation v. U.S. West NewVector Group, a Delaware corporation (counterclaim)

Arizona State Superior Court, Maricopa County
Case No. CV2000-000972
Client: US West NVG
Deposition 2002

Salt Lake Tribune Publishing Company, LLC v. MediaNews Group Inc., et al.

United States District Court, District of Utah, Central Division
Case No. 2:00-CV-936-ST
Client: MediaNews Group
Deposition 2002

In the Matter of MSC.Software Corporation

United States of America before Federal Trade Commission
FTC Docket No. 9299
Client: MSC.Software Corporation
Deposition 2002

The Canopy Group, Inc., a Utah corporation; and Center 7, Inc., a Utah corporation v. Computer Associates International, Inc., a Delaware corporation

United States District Court, District of Utah, Central Division
Case No. 2:01CV00237C
Client: Canopy Group and Center 7
Deposition 2003

Rocky Mountain Medical Center, Inc, a Delaware corporation v. Northern Utah Healthcare Corporation, d/b/a St. Mark's Hospital, a Utah corporation, HCA Inc., a Delaware corporation and Columbia Ogden Medical Center, Inc., d/b/a MountainStar Healthcare Network, a Utah corporation

Third Judicial District Court of Salt Lake County, State of Utah
Case No. 000906627
Client: Rocky Mountain Medical Center
Deposition 2003

James M. Abraham, O.D., et al. v. Intermountain Health Care, Inc., et al.

United States District Court, District of Utah, Central Division
Case No. 2:01CV-919J
Client: Intermountain Health Care
Deposition 2003, Pretrial Testimony 2004

Headwaters Incorporated v. AJG Financial Services, Inc.

Fourth Judicial District Court of Utah County, State of Utah
Case No. 000403381
Client: AJG Financial Services, Inc.
Deposition 2004

Darol Forsythe, an individual, John Forsythe, an individual, 1, 4Group, Inc., an Idaho corporation v. Tri-River Chemical Company, Inc., a Washington corporation, d/b/a UAP Northwest; Aceto Agricultural Chemicals, Corp., a New York corporation; and United Agri Products, a Colorado corporation

United States District Court, District of Idaho
Case No. 99-0482-S-ECR
Client: United Agri Products
Deposition 2005

General Auto Parts Company, an Idaho corporation v. General Parts Company, a Georgia corporation, and Dynaparts, LLC, a Georgia Limited Liability Company

United States District Court, District of Idaho
Case No. CV 04-379-S-EJL
Client: General Parts Company and Dynaparts, LLC
Deposition 2006

The SCO Group, Inc. v. International Business Machines Corporation

United States District Court, District of Utah, Central Division
Case No. 2:03CV-0294 DAK
Client: International Business Machines
Deposition 2006

Boss Industries, Inc. v. Yamaha Motor Corporation, USA

United States District Court, District of Utah, Central Division
Case No. 2:05CV-00422 DAK
Client: Yamaha Motor Corporation, USA
Deposition 2006

Farm Bureau Insurance Companies v. American National Insurance Company, et al.

United States District Court, District of Utah, Central Division
Case No. 2:03CV00646TC
Client: American National Insurance Company
Deposition 2007, Trial Testimony 2008

Lance DeStwolinski v. Citigroup Global Markets, Inc.

Arbitration
Client: Citigroup Global Markets
Testimony October 2007

Climax Monlybdenum Company v. Molychem v. Phelps Dodge Corporation
United States District Court, District of Colorado
Case No. 1:02-CV-00311 RPM
Client: Phelps Dodge Climax
Deposition 2007, Trial Testimony October 2007

IGT v. Bally Technologies, Inc. and Bally Gaming International, Inc.
United States District Court, District of Nevada
Case No. CV-S-04-1676-RCJ-RJJ
Client: Bally Technologies, Inc.
Deposition 2007

Smile, Inc. Asia PTE Ltd v. Britesmile Management, Inc. and Britesmile, Inc.
Third Judical District Court Salt Lake County, State of Utah
Case No. 020903521
Client: Britesmile, Inc.
Deposition 2007, Pretrial Testimony June 2007

Tee Time Arrangers, Inc. v. Vistoso Gold Partners, LLC
Supreme Court State of Arizona, County of Maricopa
Case No. CV2004-013105
Client: Tee Time
Deposition 2007

Arthur Benjamin v. eCollege.com and Datamark, Inc.
United States District Court, District of Utah, Central Division
Case No. 2:05CV01033 JTG
Client: eCollege.com
Deposition 2007, Arbitration Testimony May 2008

Cliff Butler et al v. Access Microsystems, Inc. et al
United States District Court, District of Utah
Case No. 97-0905242
Client: Technology Integration Group
Deposition/Trial 2006

InSyst Ltd. v. Applied Materials, Inc., et al
California Superior Court
Case No. 104CV024251
Client: Applied Materials, Inc.
Deposition March 2008

Summit Electric Supply Company, Inc. v. International Business Machines Corporation
United States District Court, District of New Mexico
Case No. CIV 07-431 MCA/DJS
Client: International Business Machines Corporation
Deposition February 2009, Deposition August 2009

American Renal Associates, LLC v. Davita, Inc. and Total Renal Care, Inc.
United States District Court, District of Colorado
Case No. 08-cv-00513-CMA-KMT
Client: American Renal Associates, LLC
Deposition July 2009

PrizeWise, Inc. v. Oppenheimer & Co., Inc.
United States District Court, District of Utah, Central Division
Case No. 2:07CV00792 TC
Deposition November 2009

Appendix D: Group and Value Analysis

184. Prof. Cockburn utilizes a Group and Value method to allocate the value of the entire 2006 portfolio to the patents and copyrights in suit. His method consists of:

1) Identification of the patents that would likely have been included in the 2006 portfolio. [redacted]

2) [redacted]

3) Determination of the typical distribution of the value of individual patents in a portfolio of patents. Prof. Cockburn identifies three academic studies regarding the distribution of patent values.[106] He applies his own analysis to these studies (fitting a Pareto distribution), and concludes that in these studies the top 3.9% of the patents represent 67.9%, 77.1% or 91.9% of the total value of all patents in the study, depending on the study utilized.[107]

4) Prof. Cockburn assumes that each patent in the group would have equal expected value.[108] Professor takes the "middle" of the three percentages in step

106 Gambardella A., P. Giuri, and M. Mariani, "The Value of European Patents - Evidence from a Survey of European Inventors," Final Report of the PatVal EU Project, January 2005.

Harhoff D., F. Scherer, K. Vopel, "Citations, family size, opposition and the value of patent rights" Research Policy 32, October, 2002, pp. 1343-1363.

Barney, J. A., "A Study of Patent Mortality Rates: Using Statistical Survival Analysis to Rate and Value Patent Assets," AIPLA Quarterly Journal, Vol. 30, No. 3, Summer 2002.

107 Third Expert Report of Prof. Cockburn 2/3/2012 paragraphs 405 – 408 and his exhibit 34.

108 Third Expert Report of Prof. Cockburn 2/3/2012 paragraph 409.

(3), and [redacted]

5) [redacted]

6) [redacted]

7) [redacted]

185. Dr. Leonard, Google and the Court make several criticisms of Prof. Cockburn's Group and Value analysis. These include:

1) Prof. Cockburn assumes the [redacted] will follow the same distribution as patents in the three studies. This assumption may not be valid because: (a) [redacted] are owned by a single firm, while the groups of patents in the three patent studies are owned by numerous companies; (b) two of the three patent studies analyze patents in Europe, not the US; (c) The one study that analyses US patent values does so on the basis of management fees; (d) the three patent studies analyze patents from a wide range of industries, not just software patents; (e) the studies examine patents issued at different time periods.

2) The distribution of patent values in the three studies differ significantly from each other;

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[109] 4.5% = 1 / 22.

[110] Third Expert Report of Prof. Cockburn 2/3/2012 paragraph 420.

3) [redacted]

[redacted]

[redacted] I find that while some of Dr. Leonard's criticisms do have some validity in my opinion, they do not render Prof. Cockburn's Group and Value analysis economically unreliable. Dr. Leonard is correct that the [redacted] owned by a single firm, while the patents in all the patent value studies are owned by different firms and/or individuals. However, I do not see any reason that patents owned by a single firm should have a different distribution of value than a large group of patents selected by another neutral selection method.[111] Thus, I am not persuaded that this difference between the Sun portfolio and the synthetic portfolios leads to any systematic bias.

187. I also do not believe that reliance on European patents would bias Prof. Cockburn's results upward. If anything, the patent valuation studies that focus on US patents tend to show a higher percent of the total portfolio value is represented by the top patents (though the number of US studies is small). See Exhibit D1.

188. I also do not believe it to be material that the studies Prof. Cockburn relies upon study patents in all industries, rather than focusing on software. As shown in Exhibit D1, studies of patents in different industries do not show systematic differences in skew, and studies that look at the Electronics industry patents tend to finds a more skewed distribution than studies that look at all industries (although this is a weak conclusion). [112] Final-

[111] By neutral I mean any method that does not explicitly seek to sample only high value or low value (or perhaps middle value) patents.

[112] The single study that specifically examines "computer-related" patents (Lanjouw 1998) finds a lower-than-average skew.

ly Exhibit D1 does not indicate that the skewness of patent distributions has decreased over time.

189. I also disagree with Dr. Leonard that, because renewal fees are small relative to the value of the patents in question, one cannot infer the values of patents by looking at renewal decisions. In these studies, the extreme tail of the distribution is estimated from multiple observations at all other points in the distribution. For example, suppose it costs \$4,000 to renew a patent in the 20th year of its life. To get to that point, the patentee had to pay all the previous renewal fees, and (on average) experienced all of the years of depreciation (which, for patents, is estimated to be very high – typically in the 15% per year range). This means that a patent that is worth at least \$4,000 in year 20 was originally worth at least $\$4,000 / 0.85^{19} = \$88,000$. Since these studies typically obtain very good fits to the renewal decisions made prior to the final year, it is reasonable to conclude this shape continues into the extreme tail as well ((where a small fraction of the most valuable patents – typically less than 10% of the total – are renewed to the statutory maximum patent length). The same observation is even more true for studies based on an inventor's international patent application decisions in which the cost of filing is much higher than the cost of renewal, and the unobserved tail probability (and thus the share of the value distribution obtained by extrapolation) is much smaller.

190. Dr. Leonard (and the Court) is also concerned that the value of the top patents from the three studies Prof. Cockburn cites vary widely. This is obviously of some concern. However, my review of the studies in Exhibit D1 and the analysis in Putnam (2011), indicate that the skewness of patent value distributions is fairly stable across most studies.[113] As Dr. Putnam shows, under the assumption of a log-normal distribution every patent's share depends only on the value of sigma (which would be the standard devia-

113 Putnam, Jonathan, "Patent Portfolios, Apportionment, and the Adding-Up Constraint," December 2011.

tion if we were using a normal distribution).[114] Exhibit D1 shows the variation in sigma for published large-sample studies, which focus on a variety of countries, industries, time periods and use a variety of estimation methods. The value of sigma varies somewhat from study to study, but is typically found to be about 1.7. As is discussed in Putnam 2011, for any given study, the value of sigma tends to be smallest in the very upper tail. However, for most points of the distribution, the value of sigma does not have much influence on any patent's share. We are concerned here with the top 3.9% point of the distribution, for which the variation in sigma will have at most a moderate impact on the value of the average patent located within the top 3.9% of the portfolio.

191. Dr. Leonard also worries that there may be sample selection bias in Oracle's selection of the [redacted] that would have comprised the 2006 portfolio. I am not able to evaluate whether the sample was selected in a manner than induced bias, but note that the effect on Prof. Cockburn's results from any such selection bias is ambiguous and likely to be small. For instance, if Oracle was over-inclusive (by "stuffing the ballot box" with irrelevant patents), this could artificially inflate the rank of a valuable patent (for instance advancing a patent that ranks in the top 10% of all relevant patents to the top 5% of all [relevant + irrelevant] patents). However, this procedure also lowers the value of the mean patent in the distribution, against which the value of the subject patents is defined, partially offsetting the effects of that distortion.[115] More generally, it is unclear that any such selection systematically alters sigma, and if so in what direction. Dr. Leonard offers no reason to think that the selection of patents by Oracle would lead to biased estimates of sigma.

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[114] The intuitive way to think about sigma is that it captures the degree of inequality of the shares. If sigma is 0, the shares are perfectly equal.

[115] Putnam (2011) provides a formula for undoing the effects of such "inflation," depending on the form it takes and its effect on the ranking of the patents of interest.

192. With regard to step 5, I believe that the results of the conjoint analysis are reliable evidence, supported by the results from the expanded econometric analysis, [redacted] My discussion of the conjoint analysis is in Appendix E. Also, as discussed in Appendix F, I modify Prof. Cockburn's econometric analysis to include the number of applications available on each phone model. The results of that model also indicate that the value of an increased number of applications is approximately equal to the value of increased speed.

193. However, it is my opinion that Prof. Cockburn arrives a value for the top 3.9% of the 2006 portfolio that is too high. Evaluated at the median value of sigma reported in the 20 patent valuation studies reviewed in Putnam (2011) (*i.e.,* sigma = 1.67), the top 3.9% of patents accounts for approximately 45.7% of total portfolio value. If I consider the sole study of US patents, having a sigma of 1.85, the value of the top 3.9% of patents is 52.9%. Looking at the two studies of patents in the Electronics industry (there are no studies of software patents; the closest industry classification to software appears to be "Electronics"), with an average sigma of 2.355, the value of the top 3.9% of patents is 71.8%.[116] Based on these studies, I conservatively conclude that the value of the top 3.9% of the patents in the 2006 portfolio would likely represent at least half the value of that portfolio.

[116] This calculation omits Lanjouw (1998) which analyses patents for computers. Including the results from Lanjouw, the mean sigma of the 3 studies (Lanjouw, Schankerman and Deng) is 1.83. Note that Lanjouw find uniformly low sigma in all industries analyzed.

Appendix E: Professor Shugan's Conjoint Analysis

I. Introduction

194. Prof. Shugan presents results from an online survey study ("2011 Smartphone Survey") that "employed conjoint analysis to evaluate the effect of specific features (e.g., product price, operating system) and feature enhancements on consumer preferences, choices, and consumer purchasing behavior."[117]

195. Based on results from the 2011 Smartphone Survey, Prof. Shugan estimates the contribution of each feature to the total worth or utility of a smartphone product (i.e., "partworth").[118] Prof. Shugan assesses the relative importance of the features included in the survey "by examining the ranges of partworths."[119] Prof. Cockburn then uses "the relative importance to consumers of having a smartphone for which there are a large number of applications, in comparison to the importance to consumers of having a smartphone that launches applications quickly" to support his assumption that "the value of APIs that enable the development of applications….is approximately half the value of technology that ensures that applications launch within one second, the benefit [he] assume[s] is afforded by the infringed speed and memory patents."[120] The partworth estimates are also used to "simulate the effect of each feature enhancement enabled by specific patents and copyrights individually and in the aggregate on Android sales and preference shares."[121]

196. Dr. Leonard criticizes the 2011 Smartphone Survey for being "susceptible to serious biases as a result of the hypothetical and artificial nature of the exercise that survey re-

117 Expert Report of Prof. Steven M. Shugan, September 12, 2011. ("Shugan Report"), pp. 5-6.

118 Shugan Report, Appendix D, p. 15.

119 Shugan Report, Appendix D, p. 15.

120 Expert Report of Dr. Iain M. Cockburn, February 3, 2012. ("Third Cockburn Report"), p. 156.

121 Shugan Report, p. 13.

spondents are asked to complete" and claims that "respondents' stated preferences are inconsistent with economic preferences and display properties that are implausible."[122] Further, he points out certain aspects of the survey design that he views as problematic, including the omission of important attributes that may affect consumer demand.[123] He concludes that "the Shugan survey results do not form a reliable basis for calculating damages in this case."[124]

197. In this appendix, I present my analysis of the validity and reliability of the 2011 Smartphone Survey and Prof. Shugan's analysis of the survey data. I address the main criticisms raised by Dr. Leonard and additional issues I have identified regarding Prof. Shugan's conjoint analysis.

198. My analysis is organized as follows. In Section II., I discuss my effort to verify the accuracy of Prof. Shugan's results. In Section III., I investigate whether important phone features are omitted from the 2011 Smartphone Survey and assess the implications of such omissions on Prof. Shugan's results. In Section IV., I comment on the hypothetical bias issue raised by Dr. Leonard and provide an indirect evaluation of the survey response quality through the analysis of the time respondents spent on the survey. I evaluate the validity of Prof. Shugan's partworth estimates in Section V. and discuss the apparent inconsistencies between these estimates and predictions by economic theory as pointed out by Dr. Leonard in Section VI. In Section VII., I investigate the use of the relative importance between enhanced application availability and faster application launch to estimate the value of copyrighted APIs compared to the value of infringed patents. In Section VIII. I assess the validity of Prof. Shugan's market simulation exercise, assuming that the partworth estimates of his model are valid. Finally, I conclude in Section IX.

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122 Expert Report of Dr. Gregory K. Leonard, Revised October 24, 2011 ("Leonard Revised Report"), p. 108.

123 Leonard Revised Report, pp. 111-113.

124 Leonard Revised Report, p. 108.

II. Verification of Prof. Shugan's Findings

199. To provide an evaluation of Prof. Shugan's conjoint analysis, I begin by verifying Prof. Shugan's findings as described in his reports. In addition to reviewing the reports filed by Prof. Shugan and his deposition testimony, I have reviewed the backup materials provided by Prof. Shugan, including source documents, survey data, computer programs, and program output. I have also studied the Sawtooth Software that Prof. Shugan uses for his analysis.

200. Using the survey data and the Sawtooth Software, I am able to replicate the part-worth, relative importance, and market share estimates presented by Prof. Shugan. I confirm that Prof. Shugan's analysis is conducted as described in his testimony, and that there are no arithmetic errors in his calculations.[125] By replicating Prof. Shugan's results, I have also obtained more detailed information on his choice model, the estimation technique, and the simulation procedure.[126] Prof. Shugan's model and methodologies are within the norm of estimation approaches used in the marketing field.[127]

III. Omission of Phone Features that Affect Consumer Demand

201. Prof. Shugan's 2011 Smartphone Survey identifies seven features that he believes may drive smartphone demand: application multitasking, application startup time, availability of third-party applications, mobile operating system brand, price, screen size, and

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[125] While I have not identified any arithmetic errors in Prof. Shugan's analysis, I have identified several potential flaws of Prof. Shugan's analysis in relation to his assumptions and methodologies. I discuss these potential flaws in later sections of this appendix.

[126] I use the same Sawtooth Software products employed by Prof. Shugan to estimate partworths for the selected feature (CBC/HB 5.2.8) and simulate preference shares for the actual and but-for scenarios (SMRT 4.20.2).

[127] According to Sawtooth Software, choice-based conjoint (CBC) "is the most popular conjoint-related technique in use today." Further, "[b]ecause having individual-level utility data is so helpful for improving the general results of CBC studies, especially the validity of market simulators, most CBC users also employ CBC/HB [Hierarchical Bayes] analysis." (http://www.sawtoothsoftware.com/products/cbc/; http://www.sawtoothsoftware.com/products/cbc/cbchb).

voice command capabilities.[128,129] Dr. Leonard criticizes the design of the 2011 Smartphone Survey for omitting "attributes of a handset that are thought to affect consumer demand" and suggests that the survey approach is subject to hypothetical bias.[130]

202. In this section, I evaluate whether features that significantly affect consumer demand are indeed omitted from the 2011 Smartphone Survey. I also discuss the potential effects of such omission on Prof. Shugan's analysis.

203. I find smartphone features that are determinants of consumer demand omitted from the 2011 Smartphone Survey. However, the direction of bias on Prof. Shugan's results caused by these omitted features is ambiguous, and can only be fully assessed if a new survey were conducted that included the omitted features.

A. Importance of omitted features in smartphone purchase decisions

204. According to Prof. Shugan, the seven features included in his survey "were selected based on qualitative interviews and industry research."[131] He refers to interviews and focus groups conducted in relation to the 2011 Smartphone Survey, as well as six third-party sources that describe smartphone features that are valued by consumers. In addition to these sources, I have conducted my own industry research and identified seven other third-party sources that discuss important smartphone features. Exhibit E1 summarizes the features listed in each of these sources.

205. Exhibit E1 reveals that the 2011 Smartphone Survey has excluded many phone features that are described as important features more frequently than features that are part

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[128] Shugan Report, p. 10.

[129] Only some of these features are used by Prof. Cockburn in his analysis of eBay bid data. Prof. Cockburn does not use application multitasking, availability of third-party applications, or voice command capabilities. (*Expert Report of Dr. Iain M. Cockburn*, Revised September 15, 2011 ("Revised Cockburn Report"), Appendix C, Exhibit C2.)

[130] Leonard Revised Report, p. 112.

[131] Shugan Report, p. 5.

of the survey. This is true even if I consider only the sources relied upon by Prof. Shugan. Omitted features that are most frequently cited as key smartphone features include appearance or physical design, battery life, brand, browser speed, camera, ease of operation, email interface or access, media integration, network carrier, and touch screen capability.

206. It is unclear why the 2011 Smartphone Survey includes the voice command feature in lieu of other more influential phone features. Each of the remaining six features included in the 2011 Smartphone Survey is either frequently cited as an important feature (availability of applications, operating system, price, and screen size) and/or is considered as a feature affected by the alleged infringements (application startup time, availability of applications, and multitasking).

207. Prof. Shugan testified in his deposition that "the voice command features…came up…through a discussion…with Analysis Group about what to include in the analysis and what not to include in the analysis,"[132] but he did not provide details of that discussion. In his report, Prof. Shugan cites the qualitative interviews and a *PC World* article in discussing the importance of the voice commands functionality.[133]

208. The *PC World* article describes "best voice recognition apps" that can be used on multiple operating systems.[134] The app "Vlingo," which allows voice texting, can be downloaded for free on all four operating systems considered by Prof. Shugan.[135] Therefore, voice commands functionality does not appear to be a differentiating feature among the phones on the four operating systems. The inclusion of voice command functionality

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132 Videotaped Deposition of Steven M. Shugan, September 26, 2011 ("Shugan Deposition"), 30:4-8

133 Shugan Report, Appendix D, p. 12.

134 Cassavoy, Liane. "Best Voice Recognition Apps for Your Smartphone," PCWorld, July 17, 2011 (http://www.pcworld.com/article/235848/best voice recognition apps for your smartphone.html).

135 According to Vlingo's website, the full-featured Vlingo for Blackberry is free only for a limited time and is normally charged $19.99. (http://www.vlingo.com.)

appears to contradict Prof. Shugan's testimony that non-differentiating features that are not involved in the infringement dispute need not be included in the survey:[136]

> *Q. Why did you decide not to include whether or not the smartphone had a camera in the conjoint?*
>
> *A. There's a variety of reasons why that would be common among many of the features that are not included in the analysis. The major reason it wasn't necessary, there was no reason to include a camera. The -- we weren't trying to design a new smartphone. So we weren't really concerned about whether or not the camera would be helpful for better selling a smartphone.*
>
> *Another reason is that most of the smartphones that were on the market already had cameras, and so it wasn't a differentiating attribute in the sense that you couldn't -- if you were concerned about, as a consumer which product to purchase, they all had the cameras, and so that wouldn't -- even if it was very important to you to have a camera, it wouldn't influence the choice decision. It wouldn't influence the market share.*
>
> *The camera also was not something that was involved in the dispute, according to what I understood the dispute on the copyright infringements, and so it wasn't something that was related to the case."*

209. In the deposition testimony cited above, Prof. Shugan describes camera as a non-differentiating attribute because "if you were concerned about, as a consumer which product to purchase, they all had the cameras." However, camera appears to be a more differentiated feature than voice commands functionality. Industry sources that provide phone specifications list several camera-related features that often vary across different smartphones (resolution, auto-focus, and flash).[137] On the other hand, all smartphones that have the voice dialing feature with the exception of the newest iPhone 4S share the same description for voice dialing.[138] Voice-texting is not even among the features described by industry sources, perhaps because voice-texting can be obtained through an

[136] Shugan Deposition, 33:8-34:4.

[137] See Exhibit E3 for a list of the industry sources considered. Exhibit E3 also summarizes the feature descriptions provided by these industry sources.

[138] See Exhibit E3.

app download instead of a phone purchase. Therefore, the decision to include voice commands functionality but not camera features in the 2011 Smartphone Survey appears to be inappropriate.

B. Effects of omitted features on Prof. Shugan's analysis

210. Given that the 2011 Smartphone Survey does appear to have omitted certain smartphone features that are important in determining consumer demand, the next question is how the omissions may affect Prof. Shugan's analysis and his conclusions. I conclude that the omissions likely lead to bias in Prof. Shugan's estimates of partworth, relative importance, and Android share loss, but the direction of bias is ambiguous.

1. Estimates of partworths

211. The survey instructed respondents to "[a]ssume any features not listed are the same for all alternatives."[139] To the extent that this instruction is followed, the estimates of partworths for the features included in the survey should be unbiased even when other features that affect consumer preferences are omitted from the survey.[140]

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139 Shugan Report, Exhibit E-1, p. E-19.

140 In Prof. Shugan's choice model, the choice probability for each alternative is not affected by features that are constant across all alternatives. The choice probability is calculated as the exponent of the sum of partworths for the alternative divided by the sum of that exponential function across all alternatives. Any feature that is constant across alternatives can be factored out from the exponential functions of partworths and canceled between the numerator and the denominator.

212. However, both Dr. Leonard and Prof. Shugan suggest that respondents may not be holding the omitted features constant across the alternatives, but rather that the effects of variations in these features are captured by some of the included features.[141]

213. Dr. Leonard states, "Survey respondents may have imputed to the platform name or other variables (e.g., price) undescribed attributes like phone design. For example, survey respondents may have assumed (contrary to what the survey wanted them to assume) that a higher priced phone was lighter or smaller than a lower priced phone that had the same values of other described attributes."[142]

214. Prof. Shugan states that "many of the specific design characteristics that Dr. Leonard argued were missing from the 2011 Smartphone Survey are correlated with screen size – which [he] did include in the study – and are thus incorporated into the survey."[143] He also states that "respondents will tend to implicitly attribute to the brand name any excluded attributes."[144]

215. While Dr. Leonard and Prof. Shugan agree on respondents' attribution of omitted features to included features, they disagree about the effects of such attribution. Dr. Leon-

[141] Prof. Shugan states that he "never 'conceded' that the survey respondents did not hold levels constant" for features that are not part of the 2011 Smartphone Survey. While he suggests that "respondents will tend to implicitly attribute to the brand name any excluded attributes," he argues that this statement should not be characterized "as a concession that, contrary to the survey instructions, participants in [his] survey did not hold constant the non-included features that might be relevant to a smartphone purchase." He explains, "When respondents implicitly attribute aspects of other attributes to brand name it is not inconsistent with holding constant all other variables that are not included in the conjoint study." (Declaration of Steven M. Shugan in Support of Opposition to Google's Third Daubert Motion, pp. 14-15.) I disagree with Prof. Shugan. To the extent that respondents implicitly attribute to the brand name any excluded attributes, it is highly unlikely that they attribute the same levels of excluded attributes to all brand names. It is more reasonable to assume that respondents attribute to each brand name the levels of excluded attributes that are observed in the actual marketplace, which often vary across brand names according to my analysis. (See Exhibit E3.)

[142] Leonard Revised Report, p. 112.

[143] *Expert Reply Report of Professor Steven M. Shugan,* October 10, 2011. ("Shugan Reply Report"), p. 16.

[144] Shugan Reply Report, p. 17.

ard argues that "[t]he survey design can contribute to hypothetical bias."[145] He states that "[d]ue to the propensity for a survey to 'construct' preferences, the omission of other attributes and, particularly the important attributes, likely caused respondents to attach excessive preference weights to the attributes related to the patents-in-suit."[146] On the other hand, Prof. Shugan argues that the tendency of respondents to implicitly attribute any excluded attributes to the brand name "would increase the value of the Android brand name, and so such biases would reduce the value of the relevant features."[147]

216. Contrary to Prof. Shugan's opinion, the partworths of the features relevant to the allegedly infringed copyrights and patents are more likely to be overestimated than underestimated by the omissions of important smartphone features. This follows because it seems unlikely that all of the effects of the excluded attributes were attributed to features unrelated to the infringements such as brand name. For example, respondents may view phones with faster application startup time as a "faster phone" with faster browsing speeds, or even more broadly as a "better phone" with better phone features in general. While it is likely that consumers in the real marketplace largely associate phone attributes with brand, such an association is probably weakened in a hypothetical survey setting where respondents encounter phone options with unrealistic combinations of brand and other phone features. To the extent that some of the effects of the excluded features were attributed to the infringed features, the value of those infringed features would be overestimated as well.

217. Moreover, even if it were to be assumed that all of the effects of the excluded features were attributed to non-infringed features such as brand, the resulting estimate for the value of the infringed features would be an unbiased rather than an underestimated

[145] Leonard Revised Report, p. 111.

[146] Leonard Revised Report, p. 111.

[147] Shugan Reply Report, p. 17.

number. To result in an underestimation of the value of the infringed features, the positive correlation between the excluded features and non-infringed features has to be accompanied by a negative correlation between the excluded features and the infringed features. Prof. Shugan has not provided any evidence in this regard.

218. I note that the discussion so far is based on the assumption that all infringed features are included in the 2011 Smartphone Survey. To the extent that certain infringed features are excluded,[148] there are countervailing effects from these excluded but relevant features. As a consequence, the direction of the overall bias is ambiguous and hard to assess.[149]

2. Relative importance calculations

219. The relative importance of a phone feature is calculated as the range of partworths for that feature divided by the sum of ranges of partworths across all features.[150] It measures the utility from improving the feature from the least preferred to the most preferred level as a percentage of the utility from improving all features from the least preferred to the most preferred levels.

220. While unbiased partworth estimates necessarily lead to unbiased relative importance estimates, biased partworth estimates can still produce unbiased relative importance estimates. To the extent that the partworth ranges are biased by a similar factor across smartphone feature, the relative importance of the features remains the same. However,

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[148] Prof. Shugan states in his report, "I have not considered all of the feature enhancements that are enabled by the patents-in-suit. Specifically, I have not considered improvements in phone boot time (i.e., the time it takes to turn on one's Smartphone) or the improvements to battery life enabled by the patents-in-suit." (Shugan Report, p. 5.)

[149] To fully assess the overall direction of bias, one requires information on whether each omitted feature is related to the alleged infringements, the assumptions that respondents make regarding the omitted feature, and the interactions or correlations between the omitted feature and the included features. Since there are opposing effects, quantitative rather than qualitative information of the various effects are required. Such quantitative information probably requires a new survey of its own.

[150] "Interpreting the Results of Conjoint Analysis," reprinted from Orme, B. (2010) *Getting Started with Conjoint Analysis: Strategies for Product Design and Pricing Research.* Second Edition, Madison, Wis.: Research Publishers LLC, pp. 79-80. (http://www.sawtoothsoftware.com/download/techpap/interpca.pdf)

if the partworth range for a feature is biased to a larger (smaller) extent compared to the partworth range for other features, the relative importance of the feature will be overestimated (underestimated).

221. Prof. Cockburn uses "the relative importance to consumers of having a smartphone for which there are a large number of applications, in comparison to the importance to consumers of having a smartphone that launches applications quickly" to assess the value of copyrighted APIs as a fraction of the value of infringed patents.[151] Since the ratio of the relative importance of application availability (7.85%) to the relative importance of application startup time (11.17%) is 0.70,[152] it appears that Prof. Cockburn rounds this number down to 0.5 and concludes that "the value of the copyrighted API specifications in the 2006 Bundle was half the value of the patent claims in suit."[153]

222. To the extent that my understanding of Prof. Cockburn's calculations is correct, his use of Prof. Shugan's relative importance estimates to compute the patents-to-copyrights conversion factor only depends on the ratio of the partworth range for availability of applications to the partworth range for application startup time. Therefore, Prof. Cockburn's conversion factor is unbiased as long as the two partworth ranges are biased by the same percentage.

3. Market share simulations

223. In addition to measuring relative importance of smartphone features, the partworth estimates are also used to measure the effect of infringement on Android sales through

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151 Third Cockburn Report, p. 156.

152 Shugan Report, Table 1. The relative importance ratio of 0.70 is quite different from the patents-to-copyrights conversion factor assumed by Prof. Cockburn of 0.5. I note that Prof. Cockburn provides very limited descriptions of how Prof. Shugan's results are used to reach his conversion factor. I may amend my opinions if Prof. Cockburn's conversion factor is based on inputs other than the relative importance percentages.

153 Third Cockburn Report, p. 22.

market share simulations.[154] Even if the choice model produces unbiased estimates of the partworths for features included in the survey (for example, when all respondents did what they were supposed to do and held all omitted features constant across phone options), omitted features can still render Prof. Shugan's market share simulations invalid.

224. To accurately evaluate the market share of each smartphone, it is necessary to compare the total utility individuals obtain from all product features. A feature can only be ignored for two reasons—either it has a minimal effect on utility, or it is a non-differentiating feature that is identical across all smartphones. An excluded feature with minimal effect on utility also has minimal effect on market shares. A non-differentiating feature that is identical across all smartphones does not affect consumers' relative ranking of the smartphones, and therefore does not affect phone choice and market shares.

225. Exhibit E2 lists various leading smartphones identified by industry sources and Exhibit E2 presents the product attributes of these smartphones. Phone features that are identified by multiple sources as important determinants of smartphone demand (such as battery life, carrier, and touch screen capability) do vary across smartphones. Since Prof. Shugan's market share simulations do not consider these features, the resulting estimates of market shares and percentage change in Android sales are likely to be biased.

226. Due to the multiple ways that the omitted features can affect the estimated percentage loss in Android share, the direction of the bias caused by the omitted features is ambiguous, and can only be fully assessed when partworth estimates for these omitted but important features are available.[155] To obtain partworth estimates for these omitted features, a survey that includes these omitted features would have to be conducted. There-

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[154] Shugan Report, pp. 13-15.

[155] The estimated percentage loss in Android share is calculated as the difference between actual and but-for Android shares, divided by actual Android shares. The omitted features affect both the numerator and the denominator by affecting both actual and but-for Android shares. While it is possible to assess the separate effects on the numerator and the denominator, the overall effect on the ratio is difficult to determine.

fore, even just to understand the effect of the omitted features problem requires the elimination of the problem itself.

IV. Reliability of Survey Responses

227. In this section, I discuss various issues that may affect the quality and reliability of the responses in Prof. Shugan's 2011 Smartphone Survey. I first discuss the potential bias that may be caused by the hypothetical nature of the survey. Neither Dr. Leonard nor Prof. Shugan provides an analysis to establish the existence or extent of hypothetical bias in the 2011 Smartphone Survey. I then discuss an indirect evaluation of the survey response quality through the analysis of the time respondents spent on the survey. While it appears that respondents only spent a short amount of time on the survey, sensitivity analysis indicates that Prof. Shugan's results are robust to the exclusion of responses that are most likely to be unreliable.

A. Hypothetical Bias

228. Dr. Leonard argues that "stated preference surveys, such as the Shugan survey, are susceptible to serious biases as a result of the hypothetical and artificial nature of the exercise that survey respondents are asked to complete."[156] The analysis of page time discussed below also raises concern regarding bias due to the hypothetical nature of the survey, since consumers spend substantially more time in their actual phone purchase decisions than the time that they spent on answering the survey choice tasks.

229. As pointed out by Prof. Shugan, "Dr. Leonard does not prove the existence of any purported bias or attempt to evaluate the extent or direction of any purported bias in the results of the 2011 Smartphone Survey."[157] Dr. Leonard has discussed various reasons

156 Leonard Revised Report, p. 108.

157 Shugan Reply Report, p. 2.

why hypothetical surveys may be subject to various biases that can render the results unreliable,[158] but he has not conducted any analysis to assess whether those biases exist in the 2011 Smartphone Survey.[159] While Dr. Leonard has referenced studies that evaluate the extent of hypothetical bias in the estimation of willingness-to-pay, it is unclear if the findings from those studies can be applied to the 2011 Smartphone Survey because of differences in survey design and goods valued. More importantly, it is unclear if the direction and extent of hypothetical bias on willingness-to-pay is similar to the direction and extent of hypothetical bias on market simulation results.

230. The extent or direction of any hypothetical bias on estimated change in market share can be assessed, for example, by conducting a split-sample experiment that is similar to the experiments described in the hypothetical bias literature.[160] Respondents are randomly assigned to one of two groups, with half of the respondents receiving a hypothetical version similar to Prof. Shugan's 2011 Smartphone Survey. The other half of the respondents receives a survey that is identical to the hypothetical version, except that the respondent is obligated to purchase the phone at the end of the survey.[161] Neither Dr. Leonard nor Prof. Shugan has presented results from this type of experiment.

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[158] Leonard Revised Report, pp. 109-110.

[159] Dr. Leonard has discussed "signs that the stated preferences [in the 2011 Smartphone Survey] are inconsistent with the economic preferences that would be associated with actual purchasing behavior." (Leonard Revised Report, pp. 113-115.) However, it is unclear if these inconsistencies are caused by the hypothetical nature of the survey.

[160] See, e.g., Glenn W. Harrison and E. Elisabeth Rutstrom, "Experimental Evidence on the Existence of Hypothetical Bias in Value Elicitation Methods," in *Handbook of Experimental Economics Results*, Volume I, 2008, pp. 752-767.

[161] In order for an actual purchase to take place, the combinations of phone features have to be limited to those available in the actual marketplace. While this may be an issue for the purpose of estimating changes in Android shares in the but-for world, limiting survey feature levels to levels in the marketplace can still provide useful information on the direction and size of any hypothetical bias.

231. In rebutting the concern of hypothetical bias, Prof. Shugan instead argues the following:[162]

> *…even if there were such a thing as hypothetical bias with respect to consumer good decision-making, the hypothetical bias discussed by Dr. Leonard would lead [his] results to understate the value of the functionality enabled by the patents-in-suit and Java copyrights. As the article by Ding concludes, any so-called hypothetical bias would lead to an undervaluation of recognizable physical features. Ding (2007) hypothesizes that '[i]t is conjectured that under hypothetical conditions, on average, participants tend to understate their valuation for physical features they are likely to use (e.g., speakers, the power adapter) and to overstate their valuation for physical features they are unlikely to use (cassette adapter).' Hence, even accepting Dr. Leonard's criticism as valid (which it is not), it would have meant that respondents in the 2011 Smartphone Survey likely underestimated the importance of application startup time because some applications are likely used on their existing devices and startup time is obviously observed, and it would render my results overly conservative.*

232. Even assuming Prof. Shugan is correct that respondents likely underestimated the importance of application startup time because it is "obviously observed," Prof. Shugan cannot conclude that his results are overly conservative. Features unrelated to the alleged infringements, such as screen size, are also "obviously observed" by the respondents. Therefore, Ding's reasoning would conclude that respondents also likely underestimated the importance of non-infringed features. Whether Prof. Shugan's results are conservative or aggressive depends on the relative extent of underestimation between infringement-related features and other features. Prof. Shugan has not provided such assessment. Thus, I cannot conclude whether hypothetical bias would make Prof. Shugan's estimated importance of the infringed features conservative or aggressive.

B. Time spent on instructions page

233. One of the screen shots of the 2011 Smartphone Survey can be characterized as an instructions page that lays out most of the assumptions that the respondents are required to make while answering the choice questions:[163]

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162 Shugan Reply Report, p. 12.

A Comment on "Choice"

You will now select one smartphone from different, alternative smartphones based on YOUR OWN PREFERENCES.

Alternatives vary on the previously described features. Assume any features not listed are the same for all alternatives. For example, if weight is not listed, assume each alternative has the same weight.

Select the smartphone you would choose for yourself. Please ignore your employer's preferences. Choose the "none" option if no alternative is appealing.

ASSUME that the feature descriptions are ACCURATE.

For example, even if you believe a brand allows multitasking, if the description says a model of the brand does not allow multitasking ASSUME that this particular model does not have multitasking.

Even if you believe some brand has many apps, if the description says this model of the brand has few apps, ASSUME that this particular model of the brand has few apps.

Even if you believe a brand has a high price, if the description says it does not, ASSUME that this model does not.

234. These assumptions are crucial in ensuring the reliability of survey responses as well as the validity of Prof. Shugan's data analysis.

235. Prof. Shugan uses the first assumption that "any features not listed are the same for all alternatives" as a defense against the criticism that the survey omits phone attributes that affect consumer demand. Prof. Shugan explains that "relatively less important features need not be included in the conjoint analysis because these features are held constant and there is no need to make predictions about how changes in those attributes would influence market shares in my analysis."[164]

[163] Shugan Report, Appendix E-1, p. E-19.

[164] Shugan Reply Report, fn. 8, p. 5.

236. The second assumption that respondents "ignore…employers' preferences" is an assumption underlying Prof. Shugan's choice model, where each individual's trade-off among attributes is unconstrained.[165,166]

237. The assumption that respondents accept the feature descriptions to be accurate is required to allow proper interpretation of the survey responses.

238. An analysis of the time respondents spent on the instruction page indicates that many respondents spent very little time reviewing the page, which contains as many as 167 words. As shown in Exhibit E4, over 40% of the respondents spent less than 10 seconds on the instruction page, which would imply a reading speed of at least 16.7 words per second to read through the entire page. Around 75% spent less than half-a-minute, implying a reading speed of at least 5.6 words per second.

239. It appears that most respondents did not thoroughly read through the instructions. However, given that respondents are recruited from a standing internet panel,[167] they may be familiar with this type of consumer survey and know what assumptions to make without carefully reviewing the instructions.

240. To evaluate whether choices made by respondents who spent a minimal amount of time on the instruction page are systematically different from the choices made by other respondents, and the effects of such differences on Prof. Shugan's findings, I re-estimate Prof. Shugan's choice model using only responses from the 450 (out of 784) respondents who spent at least 10 seconds on the instruction page.

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165 See, for example, Sawtooth Software's manual for a description of Prof. Shugan's HB model. (CBC/HB5 v5 Software for Hierarchicals Bayes Estimation for CBC Data, Updated August 20, 2009, p. 12.)

166 I note that the violation of such assumption would render Prof. Shugan's analysis conservative. If respondents were indeed constrained by their employers' preferences, they may be less responsive to changes in feature enhancements, therefore leading to smaller changes in Android shares when feature enhancements enabled by the alleged infringements are removed from the Android phones.

167 Respondents were recruited from the Knowledge Networks panel. See Shugan Report, p. 11.

241. Exhibit E7 presents mean partworth estimates based on the re-estimated model. Except for the peculiar result that the mean partworth for 300,000 applications is estimated to be less than the mean partworth for 100,000 applications, the re-estimation results are in line with Prof. Shugan's finding that consumers generally place higher value on better smartphone features.[168]

242. Using estimates from the model that excludes respondents who spent less than 10 seconds on the instruction page, I re-calculate Prof. Shugan's relative importance estimates and the ratio of relative importance of availability of applications to relative importance of application startup time. As shown in Exhibit E8a, the ratio remains similar after the exclusion.

243. I also re-run Prof. Shugan's market simulation exercise. As shown in Exhibits E9 and E9a, the re-estimated model produces a larger reduction in Android sales but-for the alleged patent and copyright infringements. The re-estimated model that excludes respondents who spent less than ten seconds on the instruction page predicts but-for Android sales to be 10.9 percent (instead of 7.9 percent) lower if availability of applications is reduced, 28.2 (instead of 19.9) percent lower if application of startup time is increased, and 34.8 (instead of 25.7) percent lower but-for both alleged infringements.

244. While it remains unclear if responses from individuals spending little time on the instructions page are indeed unreliable, the removal of these individuals results in an increase in Prof. Shugan's preference share calculations.

[168] The mean partworth estimates from the re-estimated model cannot be compared directly to similar estimates from Prof. Shugan's original model. The choice model employed by Prof. Shugan is a standard multinomial logit model utilizing Hierarchical Bayes ("HB") estimation. In a logit regression, a scaling factor that is inversely proportional to the variance of the disturbance term is applied to all coefficients to normalize the variance of the disturbance term so that the standard formula on choice probabilities can be applied. To the extent that the variance of the random noise unexplained by the choice model differs between the two models, the partworth estimates are expected to be larger for the model with a smaller variance in random noise. Moreover, the HB model provides information on the entire distribution of partworths, not just the mean values. Comparison of two models requires information in addition to the mean partworths.

C. Time spent on choice questions

245. The 2011 Smartphone Survey is a cognitively demanding consumer survey. Respondents were asked to answer 16 choice questions, with each question describing four phones with seven attributes. Therefore, a respondent had to compare 28 pieces of information, and to make such comparison 16 times. According to a research paper cited by Prof. Shugan to support his use of 16 choice questions, "[t]he number of attributes ranged from three to six, and the number of choice tasks ranged from 8 to 20" in 21 commercial choice-based conjoint studies collected by Sawtooth Software.[169] The number of attributes in the 2011 Smartphone Survey exceeds the maximum among those conjoint studies, and the number of choice tasks is at the upper end of the distribution.

246. Analysis of the time respondents spent on each of the 16 questions indicate that most respondents do not seem to be spending enough time to process all 28 pieces of information, particularly for the later choice tasks. Exhibit E5 shows the 10th, 25th, 50th, 75th, and 90th percentiles for time spent on each choice task. Even for the first choice task, half of the respondents spent less than 35 seconds on the task, leaving them with a little over one second to process each of the 28 pieces of information. The amount of time respondents spent on each choice task declines dramatically as the survey proceeds. The median time spent on the choice task declines to only 10 seconds towards the end of the survey.

247. I have also estimated a regression model to assess whether the variation in time spent on choice questions can be explained by the complexity of the question. Respondents are expected to spend more time on difficult questions if they are seriously considering the trade-offs presented in the questions. Using the partworth estimates produced by Prof. Shugan, I calculate the estimated utility levels from the four phone op-

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169 Johnson, Richard M., and Bryan K. Orme, "How Many Questions Should You Ask in Choice-Based Conjoint Studies?" *Sawtooth Software Research Paper Series*, 1996, p. 3.

tions and compute various measures of the difficulty of choice for each choice question. A choice question is considered more difficult if the utility difference between the most preferred and second most preferred options is smaller, the utility difference between the most and least preferred options is smaller, or the variance in utility among all four options is smaller.

248. As shown in Exhibit E6, there is a statistically significant relationship between various measures of utility difference or variance and the time spent on the question, suggesting that respondents did spend more time on more difficult questions. However, the various measures of difficulty of choice only explain a small fraction of the variation in page time. The fit of the regression model improves significantly when question fixed effects are included, and even more so when respondent fixed effects are also included. The question fixed effects confirm the trend presented in Exhibit E5, with a steep decline in page time followed by a stable level starting around the eighth question. The significance of the respondent fixed effects indicates a high degree of heterogeneity in the response time across individuals. Some respondents tend to spend substantially more time on the questions than others.

249. There are at least four possible explanations for the small amount of time respondents spent on the choice questions. First, respondents may not need to process all 28 pieces of information to make a choice. Consumers may only need to evaluate a few features that are important to them. For example, consumers who are extremely loyal to an operating system brand may simply look at the operating system attribute and pick their favorite phone within a split second. Indeed, I find that 101 (12.9 percent) of the 784 respondents selected the same operating system in all choice tasks.[170]

[170] I do not find a similar percentage of respondents always choosing the same level for the other six features that are included in the survey. The number of respondents picking the same level for price, voice command, application startup time, and screen size is 21, 9, 4, and 1, respectively. None of the respondents picked the same level for number of applications and multitasking.

250. Second, the dramatic decline in response time may reflect a learning effect. Respondents may become more familiar with the choice task and make choices more efficiently over time. As they see more alternative phone options, respondents may also learn more about their preferences, making the choices easier.

251. Third, respondents may simply be trying to go through the survey quickly because they are tired, bored, or impatient.

252. Fourth, respondents may think that their responses are of little value because they are not satisfied with certain aspects of the survey design. The omission of important phone features and the use of unrealistic feature combinations may lead respondents to believe that the survey is flawed.

253. While the first two explanations imply that the survey responses are still valid despite the short amount of time spent on the choice tasks, the last two can render the survey responses unreliable. Respondents in the last two scenarios may make a choice randomly or rely on simplified rules that they do not use in actual purchase decisions. It is likely that the explanations differ across different respondents, and it is hard to differentiate one explanation from another. For example, while some respondents may pick the same operating system brand in all choice tasks because of brand loyalty, others may do so to finish the survey quickly.

254. Given that the amount of time spent on each choice question may be an indication of the quality of survey responses, I re-estimate Prof. Shugan's choice model by eliminating responses that are most likely to be unreliable based on the time the respondent spent on the page. I eliminate a choice task from the estimation if the respondent spent less than 5 or 10 seconds on the choice task. The number of observations declines by 14 and 40 percent for the 5-second and 10-second cutoff, respectively. Exhibit E7 presents the mean partworths for the re-estimated models, Exhibit E8a presents the relative importance estimates, and Exhibits E9b and E9c reports the market simulation results.

255. The effects of excluding responses based on page time for choice tasks are very similar to the effects of excluding responses based on page time for the instruction page as discussed above. The estimated mean partworths are substantially larger in the re-estimated models, indicating a reduction in variance of the random noise. Except for the finding that the estimated mean partworth for 300,000 applications is less than the estimated mean partworth for 100,000 applications, the re-estimation results are in line with Prof. Shugan's finding that consumers generally value enhancements in smartphone features.

256. The relative importance estimates based on the re-estimated models reflect a shift of relative importance from operating system brand to other features. However, the ratio of relative importance of application availability to relative importance of application startup time remains similar to the ratio based on Prof. Shugan's original estimate.

257. Finally, the market simulation exercise based on the re-estimated models produces a similar, if not larger, reduction in Android sales but-for the alleged patent and copyright infringements. Using results from the model that eliminates choice tasks that were considered in less than 5 seconds, the re-estimated model predicts but-for Android sales to be 7.4 (instead of 7.9) percent lower if availability of applications was reduced, 22.0 (instead of 19.9) percent lower if application of startup time was increased, and 27.9 (instead of 25.7) percent lower but-for both alleged infringements. Using the re-estimated model that is based on the 10-second cutoff, the reduction in Android sales is predicted to be 6.6, 27.0, and 33.6 percent for the three scenarios, respectively.

D. Time to complete survey

258. While Prof. Shugan has not presented any analysis of the page time for the instructions and the choice questions, he has conducted sensitivity analyses based on the time respondents took to complete the entire survey. In particular, he presents market simula-

tion results after excluding respondents who took less than three minutes to complete the survey and concludes that his results are robust.

259. As an alternative sensitivity analysis, I increase Prof. Shugan's three-minute threshold to five minutes, and also exclude respondents who entered the survey more than once. As presented in Exhibit E9d, the predicted loss of Android sales increases to 8.3 percent (instead of 7.9 percent) lower if availability of applications is reduced, 25.0 (instead of 19.9) percent lower if application of startup time is increased, and 31.1 (instead of 25.7) percent lower but-for both alleged infringements.

260. Using partworth estimates from the re-estimated models described above, I have also re-calculated the ratio of the relative importance of application availability to the relative importance of application startup time. In all cases, the ratio remains similar to the ratio calculated in Prof. Shugan's original model.[171]

V. Preference Estimation

261. In this section, I address several issues related to Prof. Shugan's estimation of partworths. I discuss sensitivity analyses regarding the estimation methodologies and model assumptions. I also evaluate the goodness-of-fit of Prof. Shugan's model in predicting actual survey responses, and the stability of the estimated preferences over the course of the survey. I conclude that Prof. Shugan's preference estimation is robust and provides a good fit for the data.

[171] See Exhibit E8a.

A. Treatment of the "None" option

262. The 2011 Smartphone Survey provides a "None" option in each choice task, and respondents are asked to choose that option if "no alternative is appealing."[172] Prof. Shugan excludes from his analysis any choice task where the respondent chose the "None" option.[173]

263. While it is useful to restrict the respondents to be those involved in actual phone purchase decisions since they are "expect[ed] to have formed preferences for Smartphone features based on experience and/or research,"[174] it is not necessary to restrict the analysis to include only choice tasks where a hypothetical purchase is selected. Since the hypothetical smartphone options differ from the actual feature options observed in the marketplace, it is possible that a respondent who likes an actual phone does not like any of the four phone options presented in a choice task.

264. To the extent a respondent chooses the "None" option when none of the four phone options provides a positive utility gain, such a response still provides useful information on consumer preferences. Exclusion of choice tasks where the "None" option is chosen may result in selection bias, since it is more likely for individuals placing smaller value on phone features to choose the "None" option.

265. However, there is ambiguity in the interpretation of the "None" option. While the instruction is to choose the option if "no alternative is appealing," it is unclear if the respondent actually read the instruction or how the respondent interprets the word "appealing." Moreover, given that there are omitted features that are important in consumer demand, it is unclear what assumptions each respondent makes regarding those omitted

[172] Shugan Report, Appendix E-19.

[173] There are 14 respondents who chose the "None" option in all 16 choice tasks. (Shugan Report, Exhibit 2.) For the remaining 784 respondents, 12.6 percent of data are excluded because the "None" option was selected.

[174] Shugan Report, p. 9.

features. Respondents who assume better levels for the omitted features are less likely to choose the "None" option.

266. Therefore, Prof. Shugan's decision to exclude choice tasks where the respondent selected the "None" option can be a reasonable one. To ensure that his results are robust with respect to the exclusion, I re-conduct Prof. Shugan's analysis by including all choice tasks. As shown in Exhibits E7, E8a, E9, and E9e, the partworth, relative importance, and market share estimates remain similar to Prof. Shugan's original estimates.

B. Simple logit model

267. In estimating the contribution of each feature to the total worth or utility of a smartphone product (i.e., "partworth"), Prof. Shugan employs "a standard multinomial logit model utilizing widely employed Hierarchical Bayes ('HB') estimation."[175] The HB model has two levels: at the higher level, individuals' partworths are assumed to follow a multivariate normal distribution; at the lower level, given each individual's partworths, the probability of the individual choosing a particular alternative is governed by a multinomial logit model.[176]

268. I estimate a simple logit model that constitutes the lower level of the HB model. Instead of allowing partworths to vary across individuals, the simple logit model assumes that all individuals share the same partworths. Any variation in choices unexplained by the fixed partworths is assumed to be part of random noise.

269. The HB model is, in principal, superior to the simple logit model because it accounts for heterogeneity in preference across individuals. By imposing homogeneity, the simple logit model attributes the systematic preference heterogeneity to random noise that is independently distributed across choices.

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175 Shugan Report, Appendix D, p. 15.

176 Sawtooth HB Estimation Software Manual, p. 12.

270. The simple logit model relies on the assumption of Independent of Irrelevant Alternative (IIA), where the relative odds between two alternatives are not affected by changes in the remaining alternatives. Such an assumption is often violated in choice decisions.[177] For example, according to the IIA assumption, changes in Android phone features but-for the alleged infringements would divert sales to other brands in proportion to current market shares. On the other hand, the HB model predicts a larger diversion towards phones with features that are more similar to Android phones.

271. Despite the superiority of the HB model over the simple logit model in accounting for preference heterogeneity, it is still a useful exercise to estimate the simple logit model. In modeling preference heterogeneity, the HB model imposes assumptions on consumers' preference structure; the simple logit model permits an assessment of the validity of some of those assumptions.

272. The ability of the HB model to estimate individual-level partworths hinges on the assumptions that the partworths follow a multivariate normal distribution across individuals, and that consumer preference is stable across choice questions (i.e., the same set of partworths is used to determine all 16 choices of each individual). Given that the simple logit model is less demanding on the data and can be estimated using a single choice question, estimation of the model question by question allows for an evaluation of whether consumer preference appears to be stable across choice questions, as assumed by the HB model.

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[177] Many examples can be constructed to illustrate the problematic nature of the IIA property, one of which is the red bus/blue bus example. Consider the choice of commuters between taking a car and a blue bus to work. Suppose the odds ratio is 1:1 between the two modes of transportation, so that commuters have a 50 percent probability of choosing either one of the transportation modes. Now suppose a red bus is also introduced to the market. Further assume that people do not care about the color of the bus, so that commuters have an equal probability between picking the blue bus and the red bus. Under the IIA assumption of the simple logit model, the odds ratio between the car and the blue bus has to be maintained at 1:1. Consequently, the odds ratio among the three transportation modes ought to be 1:1:1, and the probability of a commuter picking each of the three transportation modes is one-third. The introduction of a red bus therefore artificially increases the probability of taking a bus from one-half to two-thirds.

273. Further, as discussed above, it appears that respondents are spending little time on the later choice questions as compared to the earlier questions. The question-by-question estimation can provide insight on whether data quality suffers as a result of the reduction in page time.

274. Finally, estimation of the simple logit model provides a sensitivity check on the robustness of Prof. Shugan's results with respect to estimation method.

275. The first column in Exhibit E10a presents estimation results of the simple logit model using the same data that Prof. Shugan uses for his HB estimation.[178] Most of the estimated coefficients are statistically significant, confirming Prof. Shugan's finding that consumers value the feature enhancements selected for his analysis.[179]

276. As shown in Exhibit E8a, the relative importance estimates from the simple logit model produces a ratio of relative importance of application availability to relative importance of application startup time that is smaller than the ratio found in Prof. Shugan's HB model. However, the ratio from the simple logit model (0.58) is closer to the 0.5 value adopted by Prof. Cockburn when compared to the ratio from the HB model (0.70).

277. The logit model predicts percentage changes in Android sales but-for Google's alleged patent and copyright infringements that are similar to those reported by Prof. Shugan. I calculate smartphone preference shares for the base case scenario and the

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[178] The logit estimates in Exhibit E10a cannot be directly compared to Prof. Shugan's HB estimates reported in Exhibit E7 for two reasons. First, I use dummy coding instead of effects coding of the feature levels to allow for an easy assessment of whether the partworths for different levels of the same feature are statistically different from one another. Second, the coefficients in the simple logit model are subject to a different scaling factor as compared to coefficients in the HB model. In a logit regression, a scaling factor that is inversely proportional to the variance of the disturbance term is applied to all coefficients to normalize the variance of the disturbance term so that the standard formula on choice probabilities can be applied. Given that the disturbance term of the logit equation captures also preference heterogeneity across individuals, the variance of the disturbance term is expected to be larger in the simple logit model. The scaling factor for the simple logit model is therefore smaller, resulting in smaller estimated coefficients. The simple logit estimates reported in Exhibit E7 are based on effects-coded variables to allow for easier comparisons with the HB estimates reported in the same exhibit. The simple logit estimates in Exhibit E7 are indeed smaller than the HB estimates.

[179] Other than the coefficients for the operating system dummies, the omitted level for each feature is the most enhanced level. Since the coefficients for the dummy-coded variables reflect the partworths relative to the omitted levels, they are negative when consumers place higher values for enhanced features.

three but-for scenarios that Prof. Shugan put forward in his report. As shown in Exhibit E9f, the simple logit model predicts but-for Android sales to be 6.9 (instead of 7.9) percent lower if availability of applications was reduced, 18.4 (instead of 19.9) percent lower if application of startup time was increased, and 24.6 (instead of 25.7) percent lower but-for both alleged infringements.

278. To assess the reliability of survey responses and the stability of reported consumer preference, I also estimate separate logit models for each of the 16 choice questions and report the results in Exhibit E10a. In most cases, both the logit estimates of the part-worths and the standard error of these point estimates remain similar across choice questions.

279. Exhibit E11 presents results of formal statistical testing of the hypothesis that part-worths are identical across choice questions. Comparing estimates from the pooled logit model using all data and estimates from question-by-question logit estimation, a likelihood ratio test fails to reject the null hypothesis that the partworths are identical across all 16 choice questions (p-value=0.9317).

280. I have also conducted hypothesis testing on whether partworths from each choice question are identical to the partworths implied by the remaining 15 choice questions as a group. I compare logit estimates from each choice question with pooled logit estimates based on data from the remaining 15 questions. The null hypothesis of identical part-worths is only rejected once (the first question) at the 5 percent level and twice (the first and the fifteenth questions) at the 10 percent level.

281. Finally, I divide the 16 questions into four groups based on question order and estimate four separate simple logit models with pooled data from four choice tasks.[180] By pooling data from four choice questions, the partworth estimates are more precise com-

180 The likelihood ratio test fails to reject the restrictions placed by pooling the data in each of the four groups.

pared to the single-question simple logit models. The null hypothesis of identical part-worths across the four groups cannot be rejected.

282. Based on the estimation results of simple logit models, I conclude that Prof. Shugan's analytical framework is robust with respect to estimation method. Further, there is evidence that consumer preference implied by the data is stable across choice questions. Despite the fact that respondents tend to spend substantially less time on the later questions, the reliability of survey responses for the later choice questions is comparable to those for the earlier questions.

C. Model Fit

283. In his report, Prof. Shugan presents results on two goodness-of-fit measures—the "hit rate," which measures "the percentage of hold-out choices that are predicted correctly with the HB estimates"; and "U^2, which is a standard statistic for measuring the amount of explained variation in the data."[181] With hit rates of over 0.7 and a U^2 statistic of 726.3 (indicating that the model explains 72.63 percent of the variation in the data), Prof. Shugan concludes that "the model has a good fit."[182]

284. I further assess the goodness-of-fit of Prof. Shugan's model by comparing the chosen phone options predicted by Prof. Shugan's HB model with the phone options actually chosen by the respondent as well as the phone options predicted by the simple logit model.

285. I first evaluate how well Prof. Shugan's HB model can predict the average behavior of the respondents. Exhibit E12 presents the percentage of time each feature level is chosen based on either actual survey responses or model predictions. The percentages

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[181] Shugan Report, Appendix D, pp. 20-21.

[182] Shugan Report, Appendix D, pp. 20-21.

based on predictions from Prof. Shugan's HB model are very similar to the percentages based on actual survey responses.[183]

286. I then evaluate how well Prof. Shugan's HB model can capture the heterogeneity in consumer preferences by comparing the percentage of respondents choosing the same feature level at least 50 percent or 75 percent of the time. As indicated in Exhibit E13, Prof. Shugan's HB model provides a significant improvement in capturing consumer heterogeneity over the simple logit model, particularly for the predictions regarding choosing the same feature level at least 75 percent of the time.

D. Respondent Heterogeneity Not Captured by Prof. Shugan's Choice Model

287. As discussed above, Prof. Shugan's choice model allows for respondent heterogeneity by assuming individuals' partworths follow a multivariate normal distribution. Such a normality assumption can be violated when there are distinct groups of subpopulations and the partworths follow a bimodal (or multimodal) distribution rather than a unimodal distribution such as the normal distribution. In these cases, estimation results based on subsamples may produce results that are substantially different from results based on the entire sample.

288. I have independently assessed the sensitivity of Prof. Shugan's results, augmenting Prof. Shugan's own sensitivity analysis, with respect to the exclusion of three subsamples that may have a preference structure that is substantially different from that of the remaining respondents: respondents whose choices were most likely to be influenced by the employer's preferences, respondents who chose the same operating system brand in all choice tasks, and respondents who intended to purchase a smartphone in the next six months at the time of the survey. Results from sensitivity analyses on market share sim-

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[183] Predicted sample averages based on the simple logit model are equal to actual sample averages by construction.

ulations, as reported in Exhibits 3c-3e of Prof. Shugan's report and Exhibits E9g and E9h of this report, indicate that Prof. Shugan's market simulation results are robust to these data exclusions. Results from sensitivity analyses on the relative importance estimates, as presented in Exhibit E8a, show that the ratio of relative importance of application availability to the relative importance of application startup time remains close to the original estimate in all but one sensitivity scenario. Either these respondents have a similar underlying preference structure as the remaining population, or the difference in the underlying preferences does not translate into a significant effect on the final estimates.

VI. Inconsistencies with Economic Theory

289. Dr. Leonard criticizes Prof. Shugan's survey results for inconsistencies with "economic preferences associated with actual purchasing behavior:"[184]

> *First, a substantial number of the survey respondents exhibited stated preferences (demand) for handsets with higher prices, all else equal – an outcome contrary to the basic economic principle that demand curves slope downward, i.e., decrease with price. An examination of the individual part-worths for the survey respondents shows that, according to their stated preferences, 24% valued a handset priced at $200 more than an otherwise equivalent handset priced at $100….Similarly, according to their stated preferences, 7% of the respondents valued a handset priced at $300 more than an otherwise equivalent handset priced at $200….*
>
> *Second, in the aggregate over the population, market demand for Android handsets (i.e., the market share function for Android handsets) increases as price increases from $100 to $200…While market demand decreases as price increases from $200 to $300, the size of the decrease is implausibly small….*
>
> *Third, with respect to speed, 26% of the respondents valued a handset with a speed of 0.2 seconds less than an otherwise equivalent handset with a speed of 2 seconds....*
>
> *In all, 49% of respondents valued higher priced handsets more than otherwise equivalent lower priced handsets, or valued slower handsets more than otherwise equivalent faster handsets, or both…*

184 Expert Report of Dr. Leonard 10/24/2011 pages 114-115.

290. Prof. Shugan's response to the criticism is three-pronged. First, he shows that his results remain stable after addressing Dr. Leonard's criticisms. Second, he suggests that the preferences estimated from the survey data can indeed exist in the real world. Third, he criticizes Dr. Leonard for ignoring the noise around the utility estimates and exaggerating the share of respondents that exhibit preferences that are allegedly inconsistent with economic theory. I discuss each of Prof. Shugan's responses below.

A. Sensitivity Analysis that Addresses Estimated Preferences that are Inconsistent with Economic Theory

291. Prof. Shugan's strongest rebuttal is the claim that "[e]ven if the issues [Dr. Leonard] raises were relevant, an experiment that adopts [Dr. Leonard's] critique further underscores the conservativeness of [the conjoint] analyses."[185] Prof. Shugan re-estimates his choice model by excluding respondents that Dr. Leonard claims have inconsistent economic preferences for price and application startup time. He also imposes monotonic preferences on price. Results from the re-estimated models show similar or larger percentage of loss in Android shares if the enhancements enabled by the alleged infringements were removed from Android phones.[186]

292. I have extended Prof. Shugan's sensitivity analyses by estimating four additional models. Three of these models involve excluding respondents that have estimated preferences for application availability, multitasking, and voice command functionality that are inconsistent with economic theory. The last model involves imposing monotonic preferences on price, application startup time, application availability, multitasking, and voice

[185] Shugan Reply Report, pp. 20-21.

[186] Shugan Reply Report, pp. 19-21.

command functionality.[187] As shown in Exhibits E9 and E9i through E9l, the estimated percentages of loss in Android shares remain similar to Prof. Shugan's original estimates.

293. While simulated market shares remain stable in the re-estimated models that address inconsistencies with economic theory, the ratio of the relative importance of application availability to the relative importance of application start up time fluctuates between 0.47 and 1.16 among all re-estimated models conducted by either Prof. Shugan or me.[188] Relative importance of a feature increases when inconsistent preferences for the feature are addressed. The ratio increases when inconsistent preferences are eliminated for availability of applications but not application startup time, decreases when inconsistent preferences are eliminated for application startup time but not availability of applications, and remains similar otherwise.

B. Legitimate Explanations for the Apparent Inconsistencies

294. Prof. Shugan also argues that the preferences described by Dr. Leonard as inconsistencies with actual purchasing behavior "are likely to be exhibited in real world purchases."[189] For example, some consumers may indeed prefer higher prices because "[t]hey prefer a more prestigious Smartphone, often implied by the phone having a higher price," or that "some consumers may use price as a surrogate measure of unobserved qualities (e.g., durability) and focus only on Smartphones in a particular price range and not consider cheap Smartphones."[190]

295. While it is plausible that a certain fraction of the population indeed prefers high price for reasons such as prestige and recognition, it is hard to imagine why as many as 26%

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187 Monotonic preference is not imposed on brand and screen size.

188 See column [h] of Exhibit E8a.

189 Shugan Reply Report, p. 19.

190 Shugan Reply Report, p. 18.

of the respondents value phones with slower application startup time. The apparent inconsistencies likely reflect effects from unobserved or excluded product features rather than actual consumer preferences. This line of argument highlights the existence of omitted features in Prof. Shugan's conjoint analysis, which may lead to biased estimates of partworths, relative importance, and Android share loss as discussed above.[191]

C. Accounting for Noise around Estimated Utilities

296. Finally, Prof. Shugan indicates that "Dr. Leonard does not account for the minimal amount of noise around the estimated utilities that is to be expected from any estimation technique."[192] He claims that after excluding "respondents with utilities associated with $100 and $200 that are within one standard deviation of the difference in utilities between levels…only 8.8 percent of respondents, not 24 percent as claimed by Dr. Leonard, prefer a price of $200 over a price of $100."[193]

297. Prof. Shugan is correct in pointing out the need to address the statistical noise around the utility estimates. While the mean utility estimate for a handset priced at $200 is higher than the mean utility estimate for a handset priced at $100 for 24 percent of the respondents, the difference may be explained by the impreciseness of the estimation technique. Therefore, a more relevant measure is the fraction of respondents for which the difference in utility is statistically significant (i.e., the difference is larger than what can be explained by statistical noise).

298. However, Prof. Shugan's standard deviation estimate may not be an appropriate benchmark in establishing statistical significance of the difference in utilities between the

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[191] In discussing the potential explanations for the inconsistencies, Dr. Leonard also suggests that "some respondents may have ascribed attribute to the handsets in the choice set in addition to those described by the survey instrument." (Leonard Revised Report, p. 115.)

[192] Shugan Reply Report, p. 19.

[193] Shugan Reply Report, p. 19.

two price levels. I note that Prof. Shugan's choice model provides 10,000 sets of utility estimates for each respondent.[194] The utility difference discussed by Dr. Leonard and Prof. Shugan is the mean utility difference calculated as an average across these 10,000 estimates. To assess the statistical significance of the mean difference for each respondent, a within-respondent standard deviation can be calculated based on the 10,000 estimates of that respondent. Instead, Prof. Shugan calculates a single standard deviation estimate that applies to all respondents by taking a single data point of mean utility difference from each respondent. Hence, his standard deviation is a between-respondent standard deviation that measures the variability in mean utility difference across respondents. The more heterogeneous the respondents, the larger Prof. Shugan's between-respondent standard deviation estimate, even when the preciseness of each respondent's mean utility difference remains unchanged.

299. In excluding respondents whose mean utility difference is within one between-respondent standard deviation, Prof. Shugan could have incorrectly excluded respondents with mean utility difference that is precisely estimated (i.e., with small within-respondent standard deviation) and incorrectly included respondents with mean utility difference that is imprecisely estimated (i.e., with large within-respondent standard deviation).

300. Further, Prof. Shugan's standard deviation measure is calculated only from individuals with a mean utility for the $200 price level that is larger than the mean utility level for the $100 price level. It is unclear why Prof. Shugan limits his calculation to estimates that fall on one side of the distribution, particularly since he speaks against interpreting the sign of the difference without accounting for noise around the estimates.

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[194] Based on the backup materials provided by Prof. Shugan (specifically, the file FonKN_A.log), his estimation procedure employs 10,000 preliminary iterations, followed by 10,000 draws per respondent.

VII. Value of Application Availability in Comparison to Value of Application Startup Time

301. In Prof. Cockburn's "group and value approach" for calculating reasonable royalty, he relies on Prof. Shugan's conjoint analysis to support his assumption that "the value of the copyrighted API specifications in the 2006 Bundle was half the value of the patent claims in suit."[195] In this section, I discuss my understanding of how Prof. Cockburn reaches the "half" value from Prof. Shugan's conjoint analysis. I also discuss two potential flaws of Prof. Shugan and Prof. Cockburn's analysis.

A. Prof. Shugan's relative importance calculations

302. Prof. Cockburn provides very limited descriptions of how he uses Prof. Shugan's conjoint analysis to reach the conversion factor of 0.5 for transforming the value of allegedly infringed patents into the value of copyrighted APIs. Given that he points to "the relative importance to consumers of having a smartphone for which there are a large number of applications, in comparison to the importance to consumers of having a smartphone that launches applications quickly" right before his claim that "Prof. Shugan's conjoint survey indicates that the value of APIs that enable the development of applications is significant…[and] is approximately half the value of technology that ensures that applications launch within one second,"[196] I assume that Prof. Cockburn's 0.5 value is derived from the relative importance estimates presented by Prof. Shugan.

303. Prof. Shugan reports relative importance estimates of 7.85 percent and 11.17 percent for availability of applications and application startup time, respectively.[197] The ratio of the two estimates is 0.7, which Prof. Cockburn apparently rounds to 0.5.198

[195] Third Cockburn Report, p. 22.

[196] Third Cockburn Report, p. 156.

[197] Shugan Report, Table 1.

304. Prof. Shugan's relative importance estimates are obtained "by examining the ranges of partworths."[199] My replication of Prof. Shugan's estimates reveals that Prof. Shugan first calculates, at the respondent level, the partworth range (difference between maximum and minimum) for each smartphone feature included in the survey. The partworth ranges for each feature are then averaged across all respondents to obtain an average partworth range for the feature. Finally, the ratio of each feature's average partworth range to the sum of averages across all features becomes the feature's relative importance.

305. As discussed in Section III.B.2., Prof. Shugan's relative importance ratio is unbiased if the partworth estimates are unbiased or the partworth ranges for different attributes are biased by the same percentage. I now discuss two additional issues concerning the validity of Prof. Cockburn's use of Prof. Shugan's relative importance estimates, based on my understanding of Prof. Cockburn's analysis.

B. Disconnect between relative importance estimates and values for APIs and patents

306. Prof. Shugan's relative importance estimates do not constitute proper measures for evaluating the value of the copyrighted APIs in comparison to the value of the patent claims in suit.

307. As explained above, relative importance estimates are based on the differences in utility between the most preferred and the least preferred feature levels (i.e., partworth ranges) for each consumer. Given that the partworth estimates are not necessarily consistent with the monotonic preference structure predicted by economic theory, the most

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198 The discrepancy between 0.7 and 0.5 can also be due to my misunderstanding of how Prof. Cockburn reaches the 0.5 value given the limited amount of information he provides. I reserve the right to amend my opinions if additional information becomes available.

199 Shugan Report, Appendix D, p. 15.

preferred or the least preferred level for an attribute varies across respondents. For example, while economic theory predicts the most preferred level of application startup time to be 0.2 second and the least preferred level of application startup time to be 4 seconds, 26% of the respondents valued a handset with an application startup time of 0.2 seconds less than an otherwise equivalent handset with a startup time of 2 seconds.[200]

308. On the other hand, the relevant measures to assess the value of the copyrighted APIs and the value of the allegedly infringed patents are differences in utilities between the actual levels of the relevant attributes and the levels of these attributes but-for the alleged copyright and patent infringements. The actual and but-for attribute levels are held constant across individuals.

309. Prof. Cockburn's conversion factor should be based on relative importance estimates that are evaluated at the actual and but-for attribute levels (hereafter "relevant relative importance") instead of Prof. Shugan's relative importance estimates, which are evaluated at the most and least preferred attribute levels allowed by the survey design, regardless of the relevance of those levels to the copyrighted APIs and the allegedly infringed patents.

310. Columns [i] through [k] of Exhibit E8a present relevant relative importance estimates that are based on the actual and but-for attribute levels for availability of applications and application startup time proposed by Prof. Shugan in his base model.[201] Prof. Shugan assumes that Android phones have 100,000 applications and an application startup time of 2 seconds under the base case scenario. Android phones in the but-for scenarios are assumed to have 40,000 applications and an application startup time of 4 seconds.[202]

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[200] Leonard Revised Report, pp. 114-115.

[201] Prof. Shugan refers to the model reported in Exhibit 3a of his report as his "base case" model. (Shugan Report, Appendix D, p. 18.)

[202] Shugan Report, Exhibit 3a.

The ratio of relevant relative importance percentages reported in column [k] is substantially smaller than the ratio of relative importance percentages reported in column [h]. However, the ratio remains close, in most cases, to the 0.5 conversion factor adopted by Prof. Cockburn.

311. It appears that Prof. Cockburn's assumptions on the actual and but-for Android phone features may be different from those adopted by Prof. Shugan in his base model. In assessing the value attributable to copyrights through number of applications available, it appears that Prof. Cockburn relies on a model that is different from Prof. Shugan's base model. While the but-for availability of applications is assumed to be 40,000 applications in Prof. Shugan's base model, the model adopted by Prof. Cockburn in his damages calculation assumes a but-for level of 6,000 applications.[203]

312. In regard to application startup time, Prof. Cockburn refers to "applications launch within one second" as "the benefit [he] assume[s] is afforded by the infringed speed and memory patents."[204] Application startup time of 0.2 second is the only attribute level included in the 2011 Smartphone Survey that is within one second.[205] Combining but-for startup time of 0.2 second with his indication that one of the allegedly infringed patents reduces camera launch time by 3.33 seconds and email launch time by 3.99 seconds,[206] but-for application startup time of 4 seconds is the only attribute level included in the 2011 Smartphone Survey that is consistent with these improvements.[207] Therefore, Prof.

203 In evaluating the value of the copyrights, Prof. Cockburn assumes an "incremental effect of applications" of -19.2%, which matches the loss of preference share for Android under a market simulation model that assumes availability of 6,000 applications for Android phones in the but-for scenario. (Revised Cockburn Report, p. 190 and Exhibit 27; Shugan Report, Exhibit 4a.)

204 Third Cockburn Report, p. 156.

205 The levels of application startup time included in the 2011 Smartphone Surveys are 0.2, 2, and 4 seconds. (Shugan Report, Appendix D, p. 8.)

206 Expert Report of Iain Cockburn, September 12, 2011, Exhibit 6.

207 As noted above, the levels of application startup time included in the 2011 Smartphone Surveys are 0.2, 2, and 4 seconds. (Shugan Report, Appendix D, p. 8.)

Cockburn seems to agree with a but-for launch time of 4 seconds, but assumes an actual launch time of 0.2 second instead of 2 seconds as in Prof. Shugan's base model.

313. I report results based on Prof. Cockburn's apparent assumptions of actual and but-for attribute levels in columns [l] through [n] of Exhibit E8a. The relevant relative importance ratio based on these assumptions (column [n]) is generally bounded by the ratio based on Prof. Shugan's relative importance estimates (column [h]) and the relevant relative importance ratio based on the actual and but-for attribute levels assumed in Prof. Shugan's base model (column [k]). In most cases, the ratio remains close to the 0.5 value adopted by Prof. Cockburn in his "group and value approach" for calculating reasonable royalty.

C. Alternate relative importance calculations

314. Prof. Shugan calculates the relative importance percentages based on average partworth ranges across all respondents. An alternative approach is to calculate relative importance percentages at the individual level, then average across respondents to obtain average relative importance percentages for the group.

315. Prof. Shugan's approach differs from the alternative approach in that his approach effectively takes a weighted average of individual-level relative importance percentages, using sum of partworth ranges across all attributes as weights. It seems more reasonable to allow all respondents to carry equal weights in determining the overall relative importance of smartphone attributes, as assumed in this alternative approach. A technical paper posted by Sawtooth Software on its website also suggests that "[w]hen summarizing attribute importances for groups, it is best to compute importances for respondents individually and then average them."[208]

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[208] "Interpreting the Results of Conjoint Analysis," reprinted from Orme, B. (2010) *Getting Started with Conjoint Analysis: Strategies for Product Design and Pricing Research.* Second Edition, Madison, Wis.: Research Publishers LLC, p. 80. (http://www.sawtoothsoftware.com/download/techpap/interpca.pdf).

316. Exhibit E8b presents results similar to those reported in Exhibit E8a, but uses the alternative approach instead of Prof. Shugan's approach to compute relative importance percentages. The estimated ratio of the relative importance of application availability to the relative importance for application startup time based on the alternative approach is generally larger than, but remains very close to, the estimated ratio from Prof. Shugan's approach.

VIII. Market Simulation

317. To measure the effect of infringement on Android sales, Prof. Shugan conducts a series of market simulations and compares Android shares under a base scenario that reflects actual product characteristics and several but-for scenarios where feature enhancements enabled by the alleged infringements are removed.209 This section evaluates the validity of Prof. Shugan's market simulation exercise, assuming that the part-worth estimates of his model are valid.

318. As discussed above, the omission of important smartphone features can render the market share simulations invalid, even with unbiased estimates of the partworths for the features included in the survey. The direction of the bias on the estimated percentage change in Android sales is ambiguous.

319. The validity of Prof. Shugan's simulation analysis also hinges largely upon the accuracy of the product attributes he feeds into the analysis. Prof. Shugan designs the base case "to reflect the features available on Smartphone models for each of the operating system brands used in the choice exercises: Android, iOS, BlackBerry, and Windows."210 The "leading smartphones" identified by Prof. Shugan are "the HTC Incredible

[209] Shugan Report, pp. 13-15.

[210] Shugan Report, Appendix D, p. 18.

(Android), iPhone 4 (Apple), BlackBerry Curve (BlackBerry), HTC HD7 (Windows Phone 7)."[211]

320. Upon reviewing the sources cited by Prof. Shugan and other industry sources identified by my independent research, I conclude that Prof. Shugan's characterization of "leading smartphones" may be subject to several flaws.

321. First, I find errors in Prof. Shugan's characterization of the four phones he uses in his analysis. Prof. Shugan specifies the screen size of the Android HTC Incredible as 4.0 inches.[212] The source cited by Prof. Shugan indicates a screen size of 3.7 inches for the phone, which is not among the three screen sizes included in the 2011 Smartphone Survey (3.5 inches, 4.0 inches, and 4.5 inches).[213] Based on the convention of rounding to the nearest attribute level included in the survey, which Prof. Shugan apparently adopts to define the screen size of other phones, the Android phone should have assumed a screen size of 3.5 rather than 4.0 inches since 3.7 is closer to 3.5 than 4.0.[214]

322. Further, it is unclear how Prof. Shugan determines the number of applications available on each of the four phones.[215] Prof. Shugan has referenced three documents that contain information on availability of applications for October 2010, January 2011, March

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[211] Shugan Report, Appendix D, p. 18, fn. 44.

[212] Shugan Report, Exhibit 3a.

[213] See "Best Android Phones," Android Central, June 17, 2011 (http://www.androidcentral.com/best-android-phones-june-2011); and the specification page for HTC Incredible accessed through the hyperlink in the article (http://www.androidcentral.com/htc-droid-incredible-specs).

[214] Prof. Shugan assumes a screen size of 4.5 inches for Windows HD7, whose actual screen size is 4.3 inches. He assumes a screen size of 3.5 inches (smallest screen size used in the survey) for Blackberry 9300, whose actual screen size is 2.4 inches. (Exhibit 3; Shugan Report, Exhibit 3a.)

[215] While Prof. Shugan discusses application availability based on sources dated April 27 and August 30 of 2011 in a footnote of his market share simulation exhibits, some of the numbers in the footnote are inconsistent with the assumptions he makes in the market share simulations. (Shugan Report, Exhibits 3a-3f.)

2011, and August 2011.216 I have also collected application availability information for November and December of 2010.217 As shown in Exhibit E14, application availability for each operating system has grown over time, and it appears that Prof. Shugan's base-case assumptions on application availability correspond to different time periods for different phones. While the number of applications Prof. Shugan assumes for Android and Apple phones appears to be from late 2010, the number of applications for Blackberry and Windows phones appears to reflect availability in the second half of 2011. To make an apples-to-apples comparison, I propose changing the number of applications for Blackberry and Windows from 40,000 to 6,000 in order to reflect application availability in late 2010.218

323. Second, the voice commands functionality defined for the phones ignores the voice texting functionality enabled by free apps. Prof. Shugan defines the voice commands functionality based on the built-in capabilities of each phone.219 Android is the only device with built-in voice-to-text capabilities, and is assigned "voice dialing and texting" as the voice commands feature. The remaining phones are assigned "voice dialing" despite Prof. Shugan's recognition that "voice texting is available through the download of a third-party application" for all these other devices.220 Since consumers have easy access to enhanced voice commands functionality on a phones at no additional cost, it may be more appropriate to use the enhanced level as the phone attribute.

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[216] Wauters, Robin, "There Are Now More Free Apps for Android than for the iPhone Distimo," *TechCrunch*, April 27, 2011 (http://techcrunch.com/2011/04/27/there-are-now-more-free-apps-for-android-than-for-the-ios-platform-distimo/); McDougall, Paul, "Windows Phone 7 Apps Hit 30,000 Mark," *InformationWeek*, August 30, 2011 (http://www.informationweek.com/news/windows/microsoft_news/231600493); Albanesius, Chloe, "Android Market Hits 100,000 Apps," PCMag, October 25, 2010 (http://www.pcmag.com/article2/0,2817,2371436,00.asp).

[217] Distimo Report, November 2010; Distimo Report, Full Year 2010 (available for download at http://www.distimo.com/publications/).

[218] Among the application availability levels of 6,000, 40,000, 100,000, and 300,000, the 6,000 level is closest to the actual levels for Windows and Blackberry phones in late 2010.

[219] Shugan Report, Exhibit 3a.

[220] Shugan Report, Exhibit 3a.

324. Finally, the four phones selected by Prof. Shugan are not the only "leading smartphones" in the market. There are many Android phones in the market, many of which are more frequently mentioned as top-ranking Android phones by industry sources, or are ranked higher than the HTC Incredible.[221] In fact, a source cited by Prof. Shugan to support his leading smartphone selection ranks the HTC ThunderBolt and the HTC EVO 4G as having higher popularity than the HTC Incredible.[222] Moreover, these other Android phones often have features that are different from HTC Incredible.[223] While only four phone options are included in the 2011 Smartphone Survey, there is no reason to limit the number of phones to four in the market simulation exercise. Given the estimates of partworths, one can evaluate the choice probabilities for any number of choice options. Therefore, it seems appropriate to include additional smartphone options that capture features of other "leading smartphones" recognized by industry sources.

325. To evaluate the significance of the issues identified in Prof. Shugan's characterization of smartphone product attributes, I re-run Prof. Shugan's share simulation several ways. First, I keep the four phones identified by Shugan, but correct for his errors. Second, I change the voice commands functionality to include voice texting in all phones. Third, I add additional smartphones that are identified as top-selling smartphones into the analysis. Fourth, I make all three changes described above.

326. As demonstrated in Exhibits E9 and E9m through E9p, Prof. Shugan's estimates of the reduction in Android preference shares under the various but-for scenarios are robust with respect to the changes in phone specifications described above. The estimated percentage reductions in Android sales are either higher than or close to Prof. Shugan's original estimates.

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[221] See Exhibit E2.

[222] "Best Android Phones," Android Central, June 17, 2011 (http://www.androidcentral.com/best-android-phones-june-2011).

[223] See Exhibit E3.

IX. Conclusion

327. I am able to replicate Prof. Shugan's partworth, relative importance, and market share estimates to confirm that his analysis is conducted as described in his testimony. I have also confirmed that Prof. Shugan's model and methodologies are within the norm of estimation approaches used in the marketing field.

328. However, my analysis reveals a critical issue regarding Prof. Shugan's survey design. It is apparent that phone attributes that are important in consumers' smartphone purchase decisions are omitted from Prof. Shugan's 2011 Smartphone Survey. My analysis shows that such omissions likely cause bias in Prof. Shugan's results, but there is no way of determining the direction of the bias without conducting additional survey work that involves the omitted features.

329. The bias caused by omitted attributes is likely to be more severe for Prof. Shugan's market share estimates than his relative importance estimates. Prof. Shugan's relative importance estimates may be unbiased even when the partworth estimates are biased biased, provided that the partworth estimates for application availability and the partworth estimates for application startup time are biased by the same percentage. On the other hand, his market share estimates may be biased even when the partworth estimates are unbiased.

330. Putting aside the omitted attributes issue and assuming the 2011 Smartphone Survey to be a valid source for evaluating consumer preferences for smartphone features, Prof. Shugan's analysis of the survey data appears to be largely robust with respect to the exclusion of potentially unreliable survey responses, the adoption of alternative estimation techniques, the exclusion of respondents with potentially different underlying preferences, the elimination of estimated preferences that are inconsistent with economic preferences as alleged by Dr. Leonard, and changes in product attribute assumptions adopted by the market simulation exercise.

331. Exhibit E8a presents results from 21 sensitivity runs I have performed to evaluate the effect of alternative methodologies and data exclusions on the relative importance of application availability in relation to application startup time. It also summarizes estimates of relevant relative importance based on actual and but-for levels of application availability and application launch time. Exhibit E8b summarizes results from an alternative approach of calculating relative importance that puts equal weights on all respondents. These sensitivity analyses indicate that the estimated ratio of relative importance or relevant relative importance often remains similar to the ratio based on Prof. Shugan's original estimate of 0.7. To the extent that the re-calculated ratio differs substantively from Prof. Shugan's ratio, the re-calculated ratio often remains close to the 0.5 value assumed by Prof. Cockburn.

332. Exhibit E9 summarizes results from the nine sensitivity runs performed by Prof. Shugan and the 16 sensitivity runs I conducted to evaluate the effects of alternative methodologies and data exclusions on the market share simulation exercise. In most cases, the estimated percentage of reduction in Android sales in the but-for world remains similar between Prof. Shugan's original model and the re-estimated model. In fact, there is a slight tendency for the re-estimated models to produce larger estimates of reduction in Android sales. Estimates from re-estimated models that deviate most from Prof. Shugan's original estimates tend to be larger, rather than smaller, than the original estimates. Also, cases where the re-estimated model produces an estimated reduction in Android sales that is smaller than that from Prof. Shugan's original model are less frequently observed than cases where the re-estimated model produces a larger estimate in two of the three but-for scenarios.

333. In summary, due to the uncertainty surrounding the effects of the omitted features, I cannot assess the overall reliability of Prof. Shugan's conjoint analysis and Prof. Cockburn's apparent use of the conjoint analysis. However, all the sensitivity tests I have per-

formed indicate that that their results are reasonably robust with respect to the factors that I can test.

Appendix F: Econometrics

I. Introduction

334. Prof. Cockburn's estimate of the change in Android market shares from his econometric analysis was stricken in the Court's order of March 13, 2012 (Doc. 785). The Court states that the market share calculation stemming from the econometric analysis was "unreliable" and "questionable" because it adjusted consumer's willingness to pay for removing the patented features of Android phones while not simultaneously adjusting the sales price of the phone.[224]

335. The market share calculation from Prof. Cockburn's econometric analysis is the last step in a multi-step process. In the prior steps of his econometric analysis, Prof. Cockburn estimates a statistical model of consumers' willingness to pay for mobile phones. While the Court takes issue with how willingness to pay is used to estimate changes in market share, I do not read the Court's order as having taken issue with the methodology of calculating willingness to pay. Willingness to pay estimates may be useful in demonstrating that consumers value the impact of the patent and copyright matters still at issue in this suit.

336. In his Third Report, Prof. Cockburn reworks some of his econometric analysis in response, at least in part, to Dr. Leonard's criticisms of his work in this area. In this appendix I address the econometric analysis as developed in Prof. Cockburn's Second Report, Dr. Leonard's response to that report, and Prof. Cockburn's reply and supporting analyses put forward in his Third Report.

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[224] Court Order, Doc. 785, March 13, 2012, pp. 17-18.

II. Econometric Model Methodology Overview

337. Qualitative evidence suggests there are a number of highly valued functionalities considered in the purchase of a smartphone including such features as the phone's speed, the presence of a camera, Wi-Fi connectivity, gps capability, the screen size, and the amount of memory.[225] Because the patents and copyrights in suit have an effect on some of these functionalities, Prof. Cockburn seeks to value smartphone features in order to estimate the value of the relevant functionalities..

338. Prof. Cockburn's approach to determining the value to Google of the functionality enabled by Oracle's patents and copyrights is to examine the incremental market share attributable to the enabled functionality. Prof. Cockburn's approach can be thought of as a five-step process:

1) Estimate a statistical model of the value of smartphones using data from actual purchases

2) Identify how the patents and copyrights in suit affect Android smartphone features included in the statistical model

3) Predict the change in Android smartphone value from the estimated change in the phones' functionalities enabled by Oracle's patents and copyrights

4) Predict the change in Android market share due to the change in Android smartphone value

5) Estimate the change in Google revenues from the change in Android market share

225 http://www.smartphonebasics.com/what-features-to-look-for-in-a-smartphone (last accessed 3/5/2012), http://www.consumerreports.org/cro/cell-phones-services/buying-guide.htm?pn=2 (last accessed 3/5/2012), Leonard Supplemental Report, p.11. See also Exhibit E1 in Appendix E of this report.

339. The Court's order clearly strikes step four and, by extension, step five from Prof. Cockburn's report(s). However, the first step of this five-step process is the foundation of Prof. Cockburn's Econometric Model analysis and includes the actual econometrics – the remaining steps of the analysis rely upon what is done in step 1. In this first step, the value of a smartphone (as measured by willingness to pay) is broken down by the phone's characteristics. Nearly all of Google's criticisms regarding Prof. Cockburn's econometric model rest on how he implemented this first step. The following sections provide the details behind this first step of Prof. Cockburn's Econometric Model, Google's criticisms of the model, and several model adjustments and sensitivity analyses that I have undertaken.

III. The Econometric Model

340. Prof. Cockburn's econometric analysis serves as a basis for his calculation of consumer willingness to pay for smartphone features. The approach used by Prof. Cockburn is referred to in the economics discipline as hedonic analysis and, specific to econometrics, hedonic regression. Hedonic analysis uses the characteristics of a product to predict the value of the product overall (as a sum of its characteristics) as well as the value of each characteristic. Hedonic analysis is well accepted within the professional economics peer-reviewed literature and Dr. Leonard does not criticize Prof. Cockburn for his use of the methodology. Rather, Dr. Leonard's criticisms are directed at how the methodology is employed.

A. The Data

341. Prof. Cockburn's econometric model uses data from 913,556 eBay auctions for cell phones. The data he gleans from these auctions have 7,095,721 observations, where an observation represents a bidder in an auction and includes information on the bidder's

last or highest bid.[226] There are on average 7.77 bidders per auction. His data set includes auctions from 2009 through 2011 although his model is focused exclusively on data for 2010 and 2011.

342. The mix of phones auctioned on eBay is not proportional to the phone shares seen in the retail phone market. For example, there are many more auctions for iPhones as a fraction of the total number of auctions on eBay than iPhone sales as a share of the retail cell phone market. This means that the eBay data are skewed relative to the share of iPhones in the market. To adjust for this, Prof. Cockburn uses stratified random samples of auctions from the eBay data in proportion to the 2010 and 2011 smartphone market shares as identified by Strategy Analytics. Each sample is based on 20,000 auctions (10,000 each for the years 2010 and 2011). On average each sample is made up of 77,670 bids within each year.

343. Prof. Cockburn estimates his econometric model using data from these 20,000 auctions but, recognizing that his results could be an artifact of the specific sample that he drew from the larger set of eBay data, he repeats the process until he has estimated approximately 1,200 samples of 20,000 auctions. He uses the results from the 1,200 samples to identify the distribution of the model estimates. This distribution allows him to provide the 5th and 95th percentiles as confidence intervals.

B. The Model

344. Prof. Cockburn's initial (BASE) model predicts the auction bid (also referred to as "the bidder's willingness to pay" and/or "the price") as a function of the phones' characteristics, or features. Prof. Cockburn uses the 23 phone characteristics identified in Exhibit F1 to predict the auction bid. In contrast, Prof. Shugan's Conjoint Analysis is based on sev-

226 October Supplement to the Expert Report of Prof. Cockburn, Appendix C-1.

en phone characteristics (including price) – three of which are not part of Prof. Cockburn's analysis.[227]

345. I have estimated Prof. Cockburn's BASE model incorporating two additional characteristics; the number of applications that can run on a given phone at a given point in time and the availability of voice commands. The results from this analysis will be discussed below in the Section entitled "An Enhanced Model."

C. Model Estimation

346. Prof. Cockburn estimates his model by programming his own likelihood function assuming the error structure on the auction bids is a log-normal distribution. In evaluating Prof. Cockburn's work, Dr. Leonard estimated a model using a routine in SAS (a computer program for implementing regression analyses) assuming that the error structure of the log of the auction bids is a normal distribution.[228] Both Prof. Cockburn and Dr. Leonard estimate their respective models with the same variables (those identified in Exhibit F1).[229] These two estimation routines produce slightly different results. In my opinion, the differences between the two routines have little or no economic significance with regard to the issues in this case.

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227 In addition to price, the characteristics in the Conjoint Analysis are operating system brand, screen size, application startup time, application multitasking, availability of third-party applications, and voice command capabilities. Only the first three of these are related to the variables in Prof. Cockburn's Econometric Analysis.

228 Prof. Cockburn cites C. P. Adams paper "Estimating Demand from eBay Prices" published in 2007 for support of his log-normal distributional assumption (see p. 1223 of that paper). C. P. Adams *assumes* a log-normal distribution and states later in the paper that "[i]t would be straightforward but more cumbersome to allow alternative parameterizations including the Poisson distribution." (see footnote 22 on p. 1224 of the Adams paper)

229 Dr. Leonard's criticisms of the variables used in the model are addressed later.

347. Dr. Leonard argues that the likelihood function in the SAS routine he employs is identical to that programmed by Prof. Cockburn.[230] There are three parts to Prof. Cockburn's likelihood function that are algebraically different from that employed by Dr. Leonard.

1. A fudge factor: 1×10^{-10}
2. An additive factor: $WPij \quad * \ln \; n_j!$
3. A multiplicative factor: $\frac{\mathbf{1}}{\boldsymbol{exp \;\; y_{ij}}}$

Notation:
WP_{ij} = the winning price if the bidder *i* wins auction *j* (zero otherwise)
n_j = the number of bidders in auction *j*
y_{ij} = the bid of bidder *i* in auction *j*

348. The first two items identified above – the fudge factor and the additive factor – are both additive to the likelihood function and have no direct interaction with the parameter vector being used to maximize the likelihood function. The third item – the multiplicative factor – does not contain the parameter vector but is multiplied onto the part of the likelihood function that does. Exhibit F2 to this report provides the likelihood functions used by Prof. Cockburn and Dr. Leonard and shows their theoretical differences.

349. The likelihood function employed by Dr. Leonard removes all three of the items noted above. While Dr. Leonard is correct that none of these three items is directly relevant for estimating the parameters (coefficients) of the model,[231] their presence in the likelihood function does cause the coefficients being estimated by Prof. Cockburn and Dr. Leonard to be slightly different.

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[230] Leonard Deposition, 10/28/2011, p.319

[231] *Read Me.doc* received on 12/22/2011 from Dr. Leonard. The document came with a Gauss program showing the differences in the log likelihood functions. The additive item noted in the text is associated with having an unbalanced number of bidders, i.e., a different number of bidders in each auction. However, it is interesting to note that the Adams paper cited by Prof. Cockburn (noted in footnote 228 above) simplified the estimated model "by assuming that there are either 5 or 12 potential bidders … in order to make the implementation and estimation simpler." (see Adams, p. 1224). It is understood that such simplifications can lead to less accurate estimates. This cost / accuracy tradeoff is not unusual in the published literature. In other words, Dr. Leonard's assumptions in estimation and approach have support in the literature cited by Prof. Cockburn.

350. From a practical standpoint, the major difference between the two estimation procedures is the substantial difference in the amount of computing time necessary to complete the two analyses. Prof. Cockburn's model takes upward of 240 hours of computer time to produce the final estimates of the coefficients. In contrast, using the likelihood function put forward by Dr. Leonard allows the model to run in approximately one-tenth the time.

351. I am not going to weigh in on the theoretical arguments for these apparently minor differences in the likelihood functions employed by Prof. Cockburn and Dr. Leonard. Rather, I note that it is not uncommon for econometricians to impose simplifying assumptions on a model in order to operationalize the analysis (while testing the effects of the assumptions on the end result) and that both approaches produce comparable results. Given the length of time it takes to run Prof. Cockburn's model, I have used the routine in SAS as per Dr. Leonard's approach for the majority of models that I estimate. Exhibit F3 shows the differences in the estimated coefficients from the two approaches.[232] As illustrated in this table, the differences between the estimated coefficients are often at the third decimal place and the difference is just as likely to be positive as negative.

D. The Patents, the Copyrights, and the Data

352. The patents-in-suit addressed in the Prof. Cockburn's Econometric Model are '104, '205, '702, and '720. I understand that patents '205, '702, and '720 have been withdrawn with prejudice.[233] I discuss how each of the patents were used in Prof. Cockburn's model but adjust my analysis to only include the '104 that is still in suit.

[232] While I have recreated this table, it is available as Exhibit 3 to Prof. Cockburn's Reply to Dr. Leonard's Report October 10, 2011.

[233] Court Order, 3/13/2012, Doc. 786.

353. Patents '104 and '205 address speed (how fast operations are executed on the phone) and patents '702 and '720 address RAM (how much random access memory is available for the phone). In order for the Econometric Model to provide input into the value of the patents, the model needs variables that provide a measure of speed and RAM – the *linpack* and RAM variables provide these measures, respectively.

354. The *linpack* score is a benchmark used by Oracle engineers to test the speed of an Android phone. *Linpack* measures how fast a computer solves a system of linear equations and provides a score by which to evaluate how fast applications, such as a camera, will operate.[234] .

355. The *linpack* test was run 50 times on three separate Android phones. One phone had the full Android operating system. A second phone had the '205 patent disabled. The third phone had both the '104 and '205 patents disabled. I understand that it is not possible to separately disable the '104 patent.[235] The phone with the '205 patent disabled demonstrated a decrease in the *linpack* score of 79%. When both the '104 and '205 patents were disabled the *linpack* score decreased a total of 80%.[236] These impacts are summarized in the following table:

Table F1: Patents and the Econometric Variables

Patents	Effect on Econometric Variables
'205	79.4563% Reduction in *Linpack*
'104 and '205	80.1165% Reduction in *Linpack*

234 Kemerer Declaration p. 3

235 Expert Report of Prof. Cockburn 9/15/2011 Exhibit 6.

236 Kemerer Declaration, p.3

356. Since the *'205 patent alone* and the *'205 and '104 patents together* reduce the *linpack* score by about 80%, I use an 80% reduction in the *linpack* score as the measure of impact for the *'104 patent alone* analysis I put forward.[237]

357. The '702 and '720 patents affect the amount of RAM available on the Android phone. Since the '702 and '720 patents have been withdrawn, I do not calculate a change in willingness to pay for a phone with more RAM available.

358. The copyright issues in this case allegedly affect the number of applications that would have been available for the Android operating system. Prof. Cockburn's econometric analysis did not include an *applications* variable in the model, relying instead on Prof. Shugan's conjoint analysis for this assessment. As will be discussed in Section F below, I have incorporated the number of applications into the econometric analysis allowing me to identify the relative value between speed (*linpack* score) and the number of applications.

E. Data and Model Specification Issues

Data Issues

359. Dr. Leonard criticizes Prof. Cockburn's use of eBay data in his econometric analysis. Dr. Leonard asserts that because eBay data primarily shows bids on *used* phones that the results are suspect. It is often the case that the ideal data one would like to use are unavailable and a proxy for those data is required in order to proceed with the analysis. In this case, it would have been ideal if the data on new phone purchases were available and transparent. However, new phone purchases are typically bundled with one/two-year service agreements making it difficult to disentangle even the price of the phone from the service agreement let alone the value of new phone characteristics.

237 It is inappropriate to consider the impact of the '104 patent to be the 1% additional decrease in the linpack score when adding it to the impact of the '205 patent. Since the phone will not run with the '104 patent disabled, using an 80% reduction in the linpack score for the '104 patent alone is actually conservative.

360. When new phones are bundled with a service agreement, the full price of the phone is generally not observed since individuals receive the phone for a subsidized price. The subsidy on a phone varies from service provider to service provider and from phone model to phone model. In fact, estimates of the true price of a phone would require customer-by-customer information on service plans. Since the price a customer pays for a new phone is difficult to observe, Prof. Cockburn has used a proxy for that price, namely, the maximum bids on phones – many used – offered for sale on eBay.

361. Inherent in Prof. Cockburn's analysis is an implicit assumption that the value eBay participants place on speed, memory, cameras, and other phone features is comparable to how new phone purchasers at service providers value those same features. Given how Prof. Cockburn's model is estimated, it identifies the value of the phone characteristics in percentage terms.[238] This is helpful since it means that Prof. Cockburn's analysis using eBay data assumes not that the actual dollar value that an eBay participant places on a phone feature is the same dollar amount a new phone buyer would place on the same phone feature, but rather that the percentage of an eBay phone's value attributed to the feature is the same percentage as that of the new phone's value.

362. Prof. Cockburn notes in his February 24, 2012 Declaration that there is a rich economic literature surrounding the use of online data. Numerous economic theories have been tested using online data with the results appearing in peer-reviewed journals, textbooks, popular news outlets (such as *The Atlantic* and *Financial Times*), and even a *New York Times* article by Google's Chief Economist, Dr. Hal Varian, extolling online auctions as offering "a wonderful laboratory" for economists to understand participants who are "spending real money."[239] The studies using online data range from a focus on new products to combinations of new and used products to a focus on used products. In

238 The coefficients that address the patent and copyright in suit are elasticity estimates.

239 See pp. 5-8 of Cockburn's Declaration dated February 24, 2012. The NY Times article can be found at http://people.ischool.berkeley.edu/~hal/people/hal/NYTimes/2000-11-16.html (last accessed 2/25/2012).

many of the studies, the online data are serving as a proxy for data that are not otherwise available. The question before the court is the one that researchers regularly face of whether the proxy is sufficient for the purposes at hand. There is nothing that I have seen in the instant record or in the economic literature to suggest that the eBay data being used in this matter is an inappropriate proxy for the issues in this case.[240]

Modeling Issues

363. Moving from a criticism of Prof. Cockburn's reliance on eBay data, Dr. Leonard turns to Cockburn's model specification, where Dr. Leonard's principal criticisms involve the omission of certain variables.

Omitted Variable Bias

364. Dr. Leonard suggests that Cockburn's BASE model is biased because of variables not included in the model. Central to this criticism are two variables, *RAM* and *Processor Speed*. Prof. Cockburn omits *RAM* and *Processor Speed* from his model specification on the grounds that these variables are collinear with each other and with the *linpack* variable.

365. Collinearity (sometimes referred to as multicollinearity) occurs when two variables move in tandem with one another other. For example, if one variable always increases at the same time as second variable, then the two variables are said to be collinear and a statistical model has difficulty parsing out how much of the effect of an increase in the variables to attribute to each variable individually. Perfect collinearity occurs when the two variables move exactly together (think of two parallel lines).

240 Interestingly, the *New York Times* article by Dr. Varian addresses an assumption that Prof. Cockburn imposes on the eBay data, namely that the bids put in by individuals represent their maximum willingness to pay. Dr. Varian writes that individuals should report their maximum bid but the evidence shows that some individuals put in "late bids." If an individual put in a low bid but then – for whatever reason – chose to not provide a "late bid," then the low bid would appear as the person's maximum willingness to pay. However, to the extent that this occurs, the eBay data would tend to understate the true willingness to pay and Prof. Cockburn's analysis of the data is likely to err on the side of Google.

366. In regression analysis, collinearity is always a matter of degree not a matter of presence/absence. A standard measure for determining the degree of collinearity is the Variance Inflation Factor (VIF). Prof. Cockburn mentioned the VIF in his deposition[241] and states in footnote 2 of Exhibit C-2 (of his February 2012 submission) that the VIF "measures how multicollinearity has increased the instability of the coefficient estimates." While there is no theoretical rule as to what VIF level signifies too much collinearity, a general rule of thumb is that a VIF above 10 indicates significant correlation between explanatory variables.[242] Prior to including *RAM* and *Processor Speed* in the Android-only regression, the VIF associated with *linpack* is 44.[243] Including *RAM* and *Processor Speed* causes the *linpack* VIF to increase from 44 to over 70,000.

367. One piece of evidence that collinearity is an issue can be a change in the sign of estimated coefficients such as the switch from positive to negative with the inclusion of a collinear variable or a change in the sample.[244] This is evident in Dr. Leonard's Exhibits 6c and 6e from his October 3, 2011 Expert Report. In Exhibit 6c he examines a subset of the data by limiting his regression analysis to an Android-only sample and finds that the coefficient on the *linpack* variable jumps from being positive and significant to negative and significant.[245] This can suggest a high degree of collinearity between the variables in the model and the *linpack* score. Likewise, in Exhibit 6e, Dr. Leonard includes *RAM* and *Processor Speed* and the *linpack* coefficient and the *RAM* coefficient take the wrong theoretical sign. This could be an indication of the expected outcome of the regression analysis not conforming to theory (Dr. Leonard's interpretation) or it could be an indica-

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241 See Cockburn Deposition, October 17, 2011, p. 123.

242 Kennedy, Peter. A Guide to Econometrics,2nd ed., MIT Press, Cambridge, MA, 1985, p. 153.

243 See Prof. Cockburn's February 2012 Submission, Exhibit C-2.

244 Greene, William H. (2003): Econometric Analysis, 5th edition, New Jersey, Prentice Hall, p. 57, states that symptoms of collinearity include wide swings in parameter estimates, high R2 values with low significance, and coefficients with the wrong sign.

245 There are other variables that switch signs as will be noted later in this report.

tion of a high degree of collinearity (Prof. Cockburn's interpretation that is supported by the VIF scores).

368. Prof. Cockburn needed to include a model in his analysis that incorporated *RAM* because he the '702 and '720 patents affected the amount of available RAM in the phone. Even though these two patents have been withdrawn, I provide the following critique his methodology. As noted above, it is not possible to have *linpack* and *RAM* in the same model as the coefficients become unstable. Prof. Cockburn provided an alternative to excluding both *RAM* and *Processor Speed* from the analysis in his Exhibit C-4. This specification includes *RAM* but substitutes the *linpack* residual in the Econometric Model after calculating the residual from an auxiliary regression of *linpack* on *RAM* and *Processor Speed*. The results of this auxiliary regression are not presented in Prof. Cockburn's exhibits; rather, the residuals are immediately incorporated into the larger Econometric Model.

369. I have provided the results of Prof. Cockburn's auxiliary regression in Exhibit F4. This regression did not have the strong statistical relationship that might be expected between *linpack*, *RAM*, and *Processor Speed*. As can be seen in Exhibit F4, the R^2 term is 0.53 (the adjusted R^2 is 0.44) and the *Processor Speed* coefficient is statistically insignificant and of the wrong sign. The simple correlation for Android phones between RAM and Processor Speed is 0.71 and, as noted previously, when two variables are highly correlated it is not uncommon for coefficients to have the wrong sign in a regression model. Prof. Cockburn's alternative model employing the auxiliary regression is further weakened because he fails to account for endogeneity between the *RAM* variable and the *linpack* residual variable both in his main regression and as he estimates the reduced value of an Android. While the auxiliary regression is key in Prof. Cockburn's analysis to estimate a value for the '702 and '720 patents, it is weak.

370. Prof. Cockburn's alternative specification that uses the residual from his auxiliary regression shows the *linpack* coefficient increasing from the base specification. Prof. Cockburn argues that the estimates of this alternative specification are "very consistent" with the estimates from his BASE model even though the coefficient increases by over 25%.[246]

371. While Prof. Cockburn's alternative specification is no longer relevant given the withdrawal of the '702 and '720 patents, it is worth noting that I had not seen a comparable use of the residuals from an auxiliary regression as a fix to collinearity.[247]

372. Dr. Leonard argues that multicollinearity is not a generally accepted reason for omitting a variable in an econometric model.[248] This criticism goes too far, however, as nearly all econometric textbooks mention dropping variables as a strategy for coping with multicollinearity. For example:

> *Several strategies have been proposed for finding and coping with multicollinearity. … The obvious practical remedy (and surely the most frequently used) is to drop variables suspected of causing the problem from the regression. … On the other hand, overfitting – that is, trying to estimate a model that is too large – is a common error, and dropping variables from an excessively specified model might have some virtue.*[249]

373. The author of the textbook just quoted notes that dropping variables comes at a cost in that the estimated effects of the remaining variables can be biased. The reference to bias in the coefficients rests on an assumption that all variables should be included in a model. The flip-side of dropping variables is including variables that shouldn't be in the

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[246] See Prof. Cockburn's Reply to Dr. Leonard's Report October 10, 2011 paragraph 74.

[247] I had prepared an approach using the Enhance Model discussed below to estimate the value of changes in *RAM* from the '702 and '720 patents. Briefly, this approach used an alternative auxiliary regression that predicted *linpack* from *RAM* and a set of other variables. I then used the predicted changes in *linpack* from changes in *RAM* in the auxiliary regression to estimate the change in willingness to pay from the Enhanced Model. As the '702 and '720 patents have been withdrawn, I have removed this analysis from my report.

[248] See Expert Report of Dr. Leonard 10/24/2011 pages 102-103.

[249] Green, William H., Econometric Analysis, 5th ed., 2003, p. 58.

analysis; and, correlation between variables is not an *a priori* reason to include variables in the analysis. In Prof. Cockburn's econometric analysis, one could argue that all three variables need not be in the model. If speed is what customers are actually valuing and *linpack*, *RAM*, and *Processor Speed* are each proxies for speed then only one of them needs to be included in the model. Under this rationale, because *linpack* can be directly linked to the patents-in-suit, it becomes the preferred variable to include in the regression.

374. Neither Prof. Cockburn nor Dr. Leonard suggests a theoretical reason for the inclusion or exclusion of a particular variable. In so far as I know, there isn't a theoretically correct measure of speed or a best proxy. While Oracle and Google may have different views about the importance of speed to consumers, either overall or relative to other smartphone attributes, there is no disagreement that speed matters. The question is how much does speed matter?

375. Prof. Cockburn suggests an engineering proxy for the speed that consumers care about (*linpack*). Dr. Leonard suggests other measures of speed (*RAM* and *Processor Speed*). Presumably, consumers care about neither the engineering proxy nor *RAM* or *Processor Speed*, at least in a direct sense. Rather, consumers care only about the speed with which their phone boots up or brings up an application. There may be a disagreement among experts about whether a particular proxy is the best among the alternative proxies for the speed that consumers care about, but this doesn't mean that Prof. Cockburn needs to include every proxy for speed – he just needs to include one. Given the purposes for which the econometrics is being used, it is my opinion that *linpack* is a useful proxy for the speed that consumers care about.

Product-Specific Indicator Variables

376. Dr. Leonard also suggests that Prof. Cockburn's econometric model needs to include product-specific indicator variables. These proposed variables would ostensibly capture

the effects of unobserved phone attributes. However, the inclusion of these variables almost completely eliminates the reason for estimating a hedonic model. The product-specific indicator variables proposed by Dr. Leonard are perfectly collinear with the design characteristics of each specific phone. As a result, Dr. Leonard's analysis with the product-specific indicator variables automatically drops all phone characteristics that are unique to a phone model. In other words, Dr. Leonard's proposed specification renders the hedonic regression completely useless since the *linpack* variable is no longer in the model.

377. In addition, Prof. Cockburn's BASE model estimates the value of an auction bid as a function of 23 variables. The product-specific indicator variables that Dr. Leonard suggests using are perfectly collinear with 20 of the 23 variables in Prof. Cockburn's model, resulting in these 20 variables being dropped from the analysis. The three variables left in Dr. Leonard's model are the non-design phone specs, namely:

- *new* whether the phone was new
- *unlocked* whether the phone was unlocked
- *tom* time on market

378. Dr. Leonard tests his hypothesis that product-specific indicator variables should be in the model with the Hausman Specification Test.

379. The Hausman Test is used to test the efficiency and consistency of different regression specifications. In this case, Dr. Leonard is testing two regression specifications – one without the proposed product-specific indicator variables (Prof. Cockburn's model) and one with the product-specific indicator variables.[250] Dr. Leonard interprets his re-

250 "The test is based on the idea that under the hypothesis of no correlation, both [estimators] are consistent, but [the second] is inefficient, whereas under the alternative, [the second] is consistent, but [the first] is not." William H. Greene, *Econometric Analysis,* 2003. 5th Edition - p.301. A consistent estimator is one that converges to the true value of the parameter being estimated as the sample size gets larger. An efficient estimator is one that is in some manner "best." The most common comparison of efficient estimators is based on variance where an efficient estimator would have the lowest possible variance of all estimators. In this context, an inefficient estimator is one that has a higher variance.

sults as providing evidence that Prof. Cockburn's model estimates are not consistent.[251] Specifically, Dr. Leonard's interpretation of the Hausman Test is that since the three remaining variables in the model are not consistently estimated, the twenty other variables are not consistently estimated.[252] However, since none of the design-specific phone characteristics are in Dr. Leonard's proposed model, his specification test does not provide direct evidence of the consistency of the coefficients associated with these characteristics.

380. I am of the opinion that this particular application of the Hausman Test has compared two models that are sufficiently different as to make the comparison unhelpful. By dropping all design-specific phone characteristics (camera, battery life, etc.) and including a catch-all indicator variable for each phone in their place, Dr. Leonard has suggested a model specification that may consistently estimate the eBay bid value but cannot provide information about the value of the phone characteristics. Prof. Cockburn's modeling approach provides estimates of the willingness to pay for relevant phone characteristics.

Other Omitted Variables

381. Dr. Leonard criticizes Prof. Cockburn further by suggesting that he has not accounted for the fact that bidders might change their bidding behavior on previous phone versions when new models come out. As such, Dr. Leonard includes two variables to account for what he terms obsolescence, namely, a variable identifying whether a new version of the phone has been introduced (*next_generation*) and a variable measuring the amount of time since the introduction of a new version of the phone (*next_gen_out*).Dr. Leonard

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[251] Dr. Leonard's Hausman test results in a p-value less than .001 implying that one can reject the hypothesis that the three variables (new, unlocked, tom) in Cockburn's model are consistently estimated.

[252] See Supplemental Expert Report of Dr.Leonard2/17/2012 page 13

notes that including these two variables into Prof. Cockburn's BASE model "substantially" decreases the *linpack* coefficient from 0.0756 to 0.0550.[253]

382. Prof. Cockburn responds by asserting that he has accounted for obsolescence through the variables *new* (whether the phone is new) and *tom* (time on market).

383. There are two issues: The first turns on whether some or all consumers want "the latest thing." If so, then the second issue is whether Prof. Cockburn's *new* and *tom* variables are adequate proxies for the fact that individuals may have an independent interest in "the latest thing." Dr. Leonard argues that an indicator whether a phone model is the latest generation (*next_generation*) and an indicator of how long a latest generation model has been on the market (*next_gen_out*) are superior to Prof. Cockburn's proxies.

384. In this regard, Dr. Leonard's analysis potentially confounds the effects he hopes to estimate by including all four "latest thing"-related variables in his model. If the model is run using just Dr. Leonard's proxies for "the latest thing," the estimated linpack coefficient increases from 0.0756 to 0.131. I have estimated alternative specifications of the model using different combinations of Prof. Cockburn's two variables (new and tom) and Dr. Leonard's two variables (next_generation and next_gen_out). In each of these alternative specifications, I find that the estimated linpack coefficient increases vis-à-vis Prof. Cockburn's BASE model as can be seen in Exhibit F5.

The linpack Score Stability over Time

385. Dr. Leonard implements a regression that suggests that the *linpack* coefficient is not stable over time (month by month) and that the values of that coefficient range from -6.41 to +1.41.[254] However, as noted by Prof. Cockburn, Dr. Leonard did not estimate his models with sampling that is consistent with the market shares of the different operating

[253]Expert Report of Dr. Leonard 10/24/2011 page 104.

254 Expert Report of Dr. Leonard 10/24/2011 page 105.

systems. As such, the instability asserted by Dr. Leonard is an inappropriate statistical comparison with the analysis put forward by Prof. Cockburn.

386. In Exhibit C-5 of his February 2012 submission, Prof. Cockburn shows that when the model is estimated using data sampled to reflect actual market shares as is done in his BASE model, the *linpack* coefficients range from 0.064 to 0.285 with a simple average between them of 0.169. Prof. Cockburn's rebuttal analysis still demonstrates instability of the *linpack* coefficient, however, but this instability is in a much tighter range and the *linpack* coefficient never takes a negative sign. Further, it appears that had Prof. Cockburn allowed the *linpack* coefficient to vary month to month, the estimated changes in willingness to pay would have been greater that what is estimated in his BASE analysis.

387. Dr. Leonard rejects Prof. Cockburn's sensitivity analysis of the monthly variation in the *linpack* coefficients on the grounds that the other variables in the model should be allowed to vary by month as well. However, Dr. Leonard's assertions are subject to the same criticism as that associated with the monthly *linpack* coefficients, namely, his analysis is estimated month by month on data that are not stratified to reflect actual market shares. As such, he provides a statistical test that is an apples-to-oranges comparison with Prof. Cockburn's methodology.[255]

388. Prof. Cockburn's restriction of the model coefficients not varying over time produces estimates of the average affect over the time period. If the purpose of the model were to estimate the willingness to pay for a specific month, then Prof. Cockburn's restriction could potentially affect the specific month's estimate. As it is, Prof. Cockburn is estimating the change in willingness to pay over the time period and by restricting the coeffi-

[255] Allowing every coefficient to vary over time would invariably result in various stratified samples not having sufficient variation in the data to estimate all coefficients. As a result, each sample would have a different set of variables for which coefficients would be estimated and it would not be possible to make a meaningful comparison across the samples. This is seen in a small scale when viewing Dr. Leonard's Exhibit 6g in which he is unable to estimate a linpack coefficient for the first five months of data.

cients to be the same across months, he has estimated an average affect over the entire time period.

Pooling Android Phones with Other Phones

389. Dr. Leonard estimates a hedonic model on the subset of Android-phone only eBay auctions. Doing so produces a negative estimate for the *linpack* score (-0.4427). Dr. Leonard concludes that the coefficients aren't the same across operating systems and might even suggest that bidders aren't willing to pay more for speed (i.e., for a higher *linpack* score).

390. Dr. Leonard's analysis in this case accepts several practices for which he criticizes Prof. Cockburn in other places. For example, Dr. Leonard's Android-only analysis has dropped several variables from the model including *Wi-Fi*, *camera*, *gps*, *touch screen, j2me* presumably because of collinearity – a practice he dismisses elsewhere as inappropriate. Moreover, and in response, Prof. Cockburn notes that since there are only 13 Android phone models, it is not possible to estimate coefficients on 18 different phone characteristics. Dr. Leonard has not described how he determined which phone characteristics to drop from his analysis; Prof. Cockburn suggests that Dr. Leonard merely allowed the software program to "arbitrarily" drop variables.[256]

391. Prof. Cockburn also notes that Dr. Leonard's Android-only model produces perverse signs on the estimated coefficients of several variables such as better screen resolution and ability to act as a mobile hotspot. The coefficients on these variables have gone from being positive (meaning that they increase the amount a person is willing to pay for the feature) to negative (meaning that they decrease the amount a person is willing to pay for the feature). As noted previously, switching signs and instability in coefficient es-

[256] See p. 13, Cockburn's Declaration of February 24, 2012 Doc 739.

timates as the sample changes (in this case focusing only on Android phones) is a potential sign of collinearity in the model.

392. Dr. Leonard responds that the perverse signs are not a function of "his" model since he is merely running Prof. Cockburn's model. But he is not running Prof. Cockburn's model. Prof. Cockburn's model allows substitution across operating systems by having all phones in the analysis and Dr. Leonard has restricted his analysis to Android-only phones thereby imposing an implicit assumption – that buyers of Android phones would not substitute across operating systems.

393. A model that is estimated separately for each operating system cannot estimate the cross-operating system substitution that bidders make. It is clear from the data that auction participants bid on multiple operating systems, hence they are making comparisons of phone characteristics across operating systems. Estimating an Android-only model biases the estimated coefficients by not including the relevant and observable substitution contained in the data – another plausible reason for the perverse signs of Dr. Leonard's model. Even individuals who buy new phones with a two-year service agreement from a specific carrier generally have a choice of phones with different operating systems.

Prof. Cockburn uses all bids, not just the winning bid

394. A concern not raised by Dr. Leonard but one that I explored involves Prof. Cockburn's model including all bidders in an auction and not just the winning bid. Prof. Cockburn states that using all bidders in an auction helps identify the entire demand curve and not just a point on the demand curve. Implicit in Prof. Cockburn's approach is an assumption that each bid represents each participant's maximum bid (reservation price), i.e., maximum willingness to pay. The critical assumption, however, is whether the bids for non-winning auction participants represent their respective maximum willingness to pay. If a participant bid a low value just to see if she might be lucky and win the auction, for

example, then including such a bid would bias downward the estimate of the true willingness to pay.[257]

395. One way of indirectly testing the hypothesis that non-winning bids are low-ball values, is to restrict the regression analysis to winning bids and see if there is an impact on the estimated coefficients. I present the results of this analysis in in Exhibit F6. Since the coefficient of interest in the model is that associated with the linpack score, I highlight it here. Using Prof. Cockburn's BASE model with a linpack coefficient of 0.077 as the benchmark , estimating the model on winning bids only produces a linpack coefficient in of 0.159 – a 107% increase over the BASE estimate. Since restricting the econometrics to winning bids only increases the estimated value of speed, Prof. Cockburn's use of all eBay bids in an auction results in a conservative measure of willingness to pay.

F. An Enhanced Model

396. Prof. Cockburn's BASE model includes the 23 phone characteristics identified in Exhibit F1 above. Two characteristics not in that table but that are employed in the Conjoint Analysis are the number of applications that can run on a phone and the ability of the phone to carry out voice commands.

397. As I noted in Section III.B it is important to get as full of a specification of model characteristics as possible given the practical limitations that can arise in the estimation. In this case, the number of applications that can run on the operating system and the presence of voice commands seem likely to be among the smart-phone characteristics that consumers care about and should be included in a regression analysis if possible.

[257] I address a variation on this point above in footnote 240.

398. I collected data on the number of applications (*apps*) available at a given point in time by operating system. I also identified which phones in the analysis could respond to voice commands (*voice*).[258]

399. I have estimated the equivalent of Prof. Cockburn's BASE model as shown in his Exhibit C-4 but with the *apps* and *voice* variables in the analysis. The results are presented in Exhibit F8.

400. The inclusion of the *apps* and *voice* variables does not change the value of the *linpack* coefficient (0.077 in both Cockburn's BASE estimate and the Enhanced Model). Exhibit F9 presents the change in WTP associated with an 80% reduction in the *linpack* score for each Android phone for both 2010 and 2011 using the *linpack* coefficient from the Enhanced Model. This exhibit shows that relative to the average price of a particular Android phone, an 80% reduction in the *linpack* score reduces the willingness to pay between $8 and $38 with an average of $21 – these amounts represents a reduction in willingness to pay of 6.2% for the respective Android phones.

401. An advantage of this Enhanced Model is that it is possible to estimate the willingness to pay for the applications. To the degree that the in-suit copyrights enable more applications, as Prof. Cockburn has asserted, then I can use the Enhanced Model to derive an independent (of the conjoint analysis) estimate of the relative importance of speed and applications. Exhibit F10 presents the change in willingness to pay for varying limiting levels of applications on the Android operating system. This exhibit shows that relative to the average price of a particular Android phone, limiting the number of applications available on the phone between 6,000 and 40,000 results in a reduction in willingness to pay between, on average, $12 and $22. These averages include percentage changes in willingness to pay of between 2% and 7% with an average of 5%.

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[258] The *voice command* variable was created from the "voice dial" characteristic pulled by Prof. Cockburn from phonescoop.com. See Exhibit F7 for details relating to number of applications.

402. The relative value of speed to applications from the Enhanced Model is 1.1 to 1.0 which means that applications are estimated to be worth 90% of the value of speed.

IV. Conclusion

403. It is my opinion that the BASE Econometric Model put forward by Prof. Cockburn is sufficiently robust as to provide meaningful evidence of the value of the characteristics of smartphones though I believe there are modifications to the model that are preferred. For purposes of determining whether the ‘104 patent is valuable to consumers because of the functionality that it enables, the key variable in Prof. Cockburn’s model is the *linpack* score. In many of the sensitivity analyses put forward by Dr. Leonard and Prof. Cockburn – as well as the sensitivity analyses I’ve performed – the value of the coefficient on the *linpack* variable increases in alternative specifications which would increase the estimated willingness to pay for speed.

404. I have estimated an Enhanced Model by including the number of applications that can run on an operating system and the presence of voice commands in the equivalent of Prof. Cockburn’s BASE model. With this Enhanced Model it is possible to estimate the value that consumers place on the number of applications (as measured by predicted willingness to pay) and to obtain an estimate of the relative importance of speed and number of applications.

Appendix C: Materials Relied Upon

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2011-04-01 Oracle 30b6 Ntc of Google - Topic 3.pdf
2011-06-21 Oracle 30b6 Dep Ntc of Google topics 4-9.pdf
2011-07-13 Oracle 30b6 Ntc of Depo to Google Topics 10-13.pdf
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Sept report backup - GOOGLE-01-00004621.xls
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0.40 Adding Covariates -- FIXED.sas
0.61 Demand (BASE)--FIXED.sas
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Ex. A - U.S. Pat. No. 7426720.pdf
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3. Variable Details (Phone Scoop).sas
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6a. Regressions Prep - Variables.sas
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0.10 Construct Directory File Listing for Import.sas
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0.02 Set-up Estimation (BASE) - Monthly.sas
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0.61RS Demand.sas
0.7RS Parameter Estimates.sas
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Ex. 17 - OAGOOGLE0102490254-API Design for C++ (EXCERPT).PDF
Ex. 2 - List of materials considered.pdf
Ex. 3 - Comparison_Fischer591-Fischer717.pdf
Ex. B - 2nd Suppl List of Materials Considered.pdf
Ex. E - pat6026485.pdf
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Ex. 17 - OAGOOGLE0102490254-API Design for C++ (EXCERPT).PDF
Ex. 2 - List of materials considered.pdf
Ex. 21 - Henning, API Design Matters.pdf
Ex. 3 - Comparison_Fischer591-Fischer717.pdf
Ex. B - 2nd Suppl List of Materials Considered.pdf
Ex. D - Liang - Dynamic Class Loading in the JVM.pdf
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Table 10. Java ME Lost Profits

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Exhibit D1. Patent Value as Proportion of Total Portfolio

	Patent renewal models															Patent application models						
Study	Schankerman and Pakes (1986)			Pakes (1986)			Sullivan (1994)	Lanjouw (1998)				Schankerman (1998)				Bessen (2008)	Putnam (1996)		Deng (2011)			
Country	Germany	France	U.K.	Germany	France	U.K.	U.K.	German				France				U.S.	Germany	World	Europe			
Year	1952-78	1951-79	1950-76	1952-72	1951-79	1950-74	1852-76	1953-80				1969-82				1991	1974		1978-96			
Technology	All	All	All	All	All	All	All	Comp	Textile	Engines	Pharma	Pharma	Chem	Mech	Elec	All	All	All	Pharma	Elec		
Returns evolution[1]	D	D	D	S	S	S	D	S	S	S	S	D	D	D	D	D	D	D	S	S	Median	Mean
Sigma for the top 5%	1.46	1.92	1.56	0.86	1.09	0.92	1.67	0.80	0.87	0.71	0.82	1.41	1.55	1.97	2.37	1.85	1.98	1.74	2.24	2.34	1.67	1.54
Value of the top 3.9% patents as a proportion of the value of the total portfolio	37.56%	55.69%	41.41%	17.96%	24.61%	19.58%	45.74%	16.43%	18.22%	14.31%	16.93%	35.68%	41.02%	57.65%	72.34%	52.91%	58.05%	48.53%	67.83%	71.33%	45.74%	40.63%

Notes:
1. "Returns evolution" refers to the deterministic (D) or stochastic (S) process described in the text of the Putnam paper.A17

Source:
Putnam, Jonathan. "Patent Portfolios, Apportionment, and the Adding-Up Constraint", December 20, 2011.

Exhibit E1. Features Determining Smartphone Choices*

Smartphone Features	Features Included in 2011 Smartphone Survey	Sources: Focus Group/ Interviews	Third-Party Sources Cited By Prof. Shugan								Other Third-Party Sources						Source Count
		[1]	[2][1]	[3][2]	[3][3]	[3][4]	[4]	[5]	[6]	[7]	[8]	[9][5]	[9][6]	[10]	[11]	[12]	[13]	
4G									x									1
"Bloatware"		x																1
Appearance/physical design/form/shape			6				3	7, 17**			3			4	3	3	5	8
Application security concerns		x																1
Application startup time	5	x																1
Availability of applications	6	x	1	9	10	9		2	x		6	3	2					10
Availability of Bluetooth		x						19									6***	3
Availability of Wi-Fi		x						3									6***	3
Battery life while using phone/ drain by apps		x	3				5	15							5	5		6
BBM (BlackBerry Messenger)		x																1
Brand/ "Anti"-brand		x	9					9			7						4	5
Browser speed		x		2	3	3											9	5
Camera		x		1	1	1		11										5
Design of graphic user interface ("GUI")		x																1
Display resolution, quality, "Retina display"		x																1
Ease of data migration												6	5					2
Ease of typing			2															1
Ease of operation/use			5				1	5						2	1	1	2	7
Email interface/access		x		4	2	2		6									1	6
Exchangeability of battery		x																1
Familiarity with technology		x																1
Features							4				1	2	1	3	4	4		7
Future features such as RFID		x																1
GPS/navigation/maps				8	7	6											10	4
Google integration		x																1
Hardware speed		x																1
Keyboard type/ layout		x						8	x								3	4
Keyboard and touchscreen capabilities																	8	1
Instant Messaging				6	6	5												3
Media integration		x		7	8	10		14										5
Memory/Storage capacity								18										1
MMS				3	5	7												3
Multi-tasking	4	x							x									2
Network (Verizon, Sprint, etc.)		x							x		4	4	6					5
Network effect – popular models are discussed online and offer more insights/ tricks		x																1
New message LED light indicator		x																1
"Other"								16	x			5	7					4
Online/Critic's reviews			8								8							2
OEM applications											9							1
Operating system	1	x		10	9	8	2		x		2	1	3		2	2		11

Exhibit E1. Features Determining Smartphone Choices*

Smartphone Features	Features Included in 2011 Smartphone Survey	Sources: Focus Group/ Interviews	Third-Party Sources Cited By Prof. Shugan									Other Third-Party Sources							Source Count
		[1]	[2][1]	[3][2]	[3][3]	[3][4]	[4]	[5]	[6]	[7]	[8]	[9][5]	[9][6]	[10]	[11]	[12]	[13]		
Performance														1					1
Practical user interface, e.g. intuitive zooming		x																	1
Price	2	x	7					4			5	7	4						6
Programmable shortcuts		x																	1
Programmable shortcuts / positioning of apps on home screen		x																	1
Quality of hardware, including glitches and haptics		x																	1
Recommendations			10																1
Screen size	7	x	4					12	x								7		5
Security		x																	1
Social influence		x																	1
Speed of multitasking		x																	1
Sync capabilities								10											1
Threat of malware		x																	1
Touch screen		x		5	4	4		1	x										6
Video capability								20											1
Video conferencing									x										1
Voice commands	3	x								x									2
Weight		x						13											2

Notes:
*Number represents importance ranking provided by the source. Shaded rows correspond to features included in the Smartphone Survey.
**Listed twice by survey as both "Form/Shape" and "Design/Style".
***Indicated in survey as "Wi-Fi/Bluetooth enabled".
1. Used likelihood that feature was listed as "Essential" as mechanism for determining importance.
2. Responses for ages 16-34.
3. Responses for ages 35-54.
4. Responses for ages 55+.
5. Q: "What is the MOST IMPORTANT factor to you in choosing a particular smartphone?" -- used most answered features to determine preference order.
6. Q: "What are OTHER factors that are important to you in choosing a smartphone? (Check all that apply)" -- used most answered features to determine preference order.

Sources:
[1] Shugan Expert Report, Exhibit 1.
[2] SwiftKey X, *"What do smartphone users really want?"*, September 1, 2011.
[3] wdsglobal, *"Smartphones: Building profitability and loyalty in the mass-market"*, 2010.
[4] J.D. Power and Associates 2010 U.S. Wireless Smartphone Customer Satisfaction Study - Volume 2.
[5] The Nielsen Company, *"Top Reasons for Choosing Device – Smartphone vs. Feature Phone: What Were the Top 3 Reasons for Selecting Your Current Cell Phone?",* 2011.
[6] Don Reisinger, *"Enterprise Mobility: 10 Essential Smartphone Features for 2011 Models",* December 29, 2010.
[7] Cassavoy, Liane. *"Best Voice Recognition Apps for Your Smartphone,"* PCWorld, July 17, 2011.
[8] TecAce Software, Careace Smartphone Survey, *"What do smartphone users want?"*, April 2011.
[9] Business Insider, *"The Truth about Smartphones: Our Exclusive Survey iPhone vs Android"*, April 18, 2011 .
[10] J.D. Power and Associates 2011 U.S. Wireless Smartphone Customer Satisfaction Study - Volume 2.
[11] J.D. Power and Associates 2011 U.S. Wireless Smartphone Customer Satisfaction Study - Volume 1.
[12] J.D. Power and Associates 2010 Wireless Smartphone Customer Satisfaction Study - Volume 1.
[13] Realtor, *Smartphone Survey Report*, 2010.

Exhibit E2. Top Smartphones Identified by Industry Sources

Smartphone	Sources										
	Shugan Report	Sources Cited By Prof. Shugan			Other Third-Party Sources						
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]
Apple											
iPhone 3G									5		
iPhone 3GS				2		2		3	1		
iPhone 4	x			1	1	1	x	2	4	1	1
iPhone 4S							x	1			
Android											
Google Nexus One			x								
HTC Amaze 4G							x				
HTC Droid Eris			x								
HTC Droid Incredible	x	3	x	5							
HTC Droid Incredible 2		6									
HTC EVO 4G		2		4	3	3		8		3	3
HTC EVO Shift 4G		8									
HTC Hero			x								
HTC Inspire 4G		4						6			
HTC myTouch 3G			x								
HTC MyTouch 4G											4
HTC Thunderbolt		1								4	
LG G2 X 4G					2					2	
Motorola Cliq			x								
Motorola Devour			x								
Motorola Droid		7	x						2		
Motorola Droid 2 Global											5
Motorola Droid 3						4					
Motorola Droid Bionic								7			
Motorola Droid Razr							x				
Motorola Droid X		5		3							2
Samsung Behold II			x								
Samsung Droid Charge		9									
Samsung Epic 4G		10					x	9		5	
Samsung Galaxy Nexus							x				
Samsung Galaxy S 4G								4			
Samsung Galaxy S II (AT&T)							x	5**			
Samsung Galaxy S II (T-Mobile)							x	5**			
Samsung Infuse 4G					4						
Samsung Moment			x								
Samsung Nexus S					5						
Blackberry											
8300 Series (Curve, 8310, 8320, 8330, 8350i)									6		
8500 Series (Curve 8520, 8530)									3		
Bold 9700									7		
Curve 9300 3G	x										
Windows											
HTC HD 7	x										
HTC Radar 4G							x				

Exhibit E2. Top Smartphones Identified by Industry Sources

Notes:

Sources cited by Shugan, include only top *Android* phones.

**Unable to distinguish which version of Samsung Galaxy S II is being indicated by source.

When feature phones were listed among top selling phones these were skipped.

Sources:

[1] Shugan Expert Report.
[2] Android Central, *Best Android Phones June 2011*, June 17, 2011.
[3] PC World, *The Best Android Smartphones Out Now*, May 21, 2010.
[4] The NPD Group, Mobile Phone Track, Q1 2011.
[5] Rodman & Renshaw, May U.S. Cellular Handset Survey, May 2011.
[6] The NPD Group, Consumer Tracking Service, Mobile Phone Track, Q3 2011 Top 5 Handsets, Q3 2011.
[7] Cannaccord Genuity, *Monthly Channel Checks*, December 2011.
[8] The NPD Group/Retail Tracking Service, *CES 2012 Media Fact Sheet*, 2012.
[9] Nielsen, *The Top Trends for 2010*, December 22, 2010.
[10] Hudson Securities, *April U.S. Cellular Handset Survey*, April 2011.
[11] Hudson Securities, *December 2010 U.S. Cellular Survey,* December 2010.

Exhibit E3. Top Smartphones Feature Comparison

	Phones Identified by Shugan				*Phones Identified by Other Sources*	
	iPhone 4[1,2,3,4,5,6,7,8,9]	**BlackBerry Curve 9300 3G[1]**	**HTC HD 7[1]**	**HTC Incredible[1,9]**	**Apple iPhone 3G[6]**	**Apple iPhone 3GS[2,5,6,9]**
Platform	Apple	BlackBerry	Windows	Android	Apple	Apple
Carrier(s)	Sprint, Verizon, AT&T	AT&T	AT&T	*discontinued*	AT&T	AT&T
Weight	4.8 oz	3.7 oz	5.71 oz	4.6 oz	4.7 oz	4.76 oz
Dimensions	4.5" x 2.31" x 0.37"	4.29" x 2.36" x 0.55"	4.8" x 2.7" x 0.44"	4.6" x 2.3" x 0.47"	4.52" x 2.44" x 0.49"	4.55" x 2.44" x 0.48"
Battery (max)	Talk: 7 hrs Standby: 300 hrs	Talk: 5.5 hrs Standby: 348 hrs	Talk: 6.5 hrs Standby: 348 hrs	Talk: 5.2 hrs Standby: 144 hrs	Talk: 5 hrs Standby: 300 hrs	Talk: 5 hrs Standby: 300 hrs
Display Type	LCD	LCD	LCD	OLED	LCD	LCD
Display Resolution	640x960	320x240	480x800	480x800	320x480	320x480
Screen Size (diagonal)	3.5 inches	2.4 inches	4.3 inches	3.7 inches	3.5 inches	3.5 inches
Colors	16.7 million (24-bit)	65,536 (16-bit)	16 million	65,536 (16-bit)	16.7 million	16.7 million (24-bit)
Processor	1000 MHz	624 MHz	1000 MHz	1000 MHz	412 MHz	600 MHz
Internal Storage	16 GB	256 MB	16 GB	6.4 GB	16 GB	16 GB
GPS/Location	Type: A-GPS supports LBS, navigation/photo, video geo-tagging	Type: A-GPS supports LBS, navigation	Type: A-GPS turn-by-turn navigation from TeleNav, supports LBS	Type: A-GPS	Type: A-GPS supports LBS, photo geo-tagging	Type: A-GPS photo and video geo-tagging
Multiple Languages	Yes	Yes	Yes	Yes	Yes	Yes
Vibrate	Yes	Yes	Yes	Yes	Yes	Yes
Bluetooth	Yes	Yes	Yes	Yes	Yes	Yes
Mobile Hotspot capable	Yes	No	No	Yes	No	No
Computer Sync	iTunes	Yes	Yes	Yes	iTunes	iTunes
USB port type	supports charging	micro-USB connector	micro-USB connector	micro-USB connector	supports charging	supports charging
Wi-Fi	Yes	Yes	Yes	Yes	Yes	Yes
Picture ID	Yes	Yes	Yes	Yes	Yes	Yes
Ringer ID	Yes	Yes	Yes	Yes	Yes	Yes
Voice Dialing Type	speaker-independent (automatic)	speaker-independent (automatic)	speaker-independent (automatic)	speaker-independent (automatic)	No	speaker-independent (automatic)
Custom Graphics	Yes	Yes	Yes	Yes	Yes	Yes
Custom Ringtones	via iTunes only	Yes	Yes	Yes	Yes	via iTunes only
Real-Music Ringers	via iTunes only	Yes	Yes	MP3	Yes	via iTunes only
Data Tethering capable	Yes	Yes	Yes	Yes	No	No
Predictive Text Entry	Yes	Yes	Yes	Yes	Yes	Yes
Touch Screen Type	Capacitive multi-touch	No	Capacitive multi-touch	Capacitive multi-touch	Capacitive multi-touch	Capacitive multi-touch
Email Client protocols supported	POP, IMAP, Exchange built in attachment viewer (Microsoft Office, PDF)	POP, IMAP, Exchange supports push, HTML, attachments	POP, IMAP, Exchange	Exchange, POP3, IMAP	POP, IMAP, Exchange, built-in attachment viewer (Office, PDF)	POP, IMAP, Exchange, built-in attachment viewer (Microsoft Office, PDF)
MMS	Yes	Yes	Yes	Yes	No	Yes
Music Player Supported Formats	MP3, Protected AAC, AAC, Audible, Apple Lossless, AIFF, WAV	MP3, eAAC+, AAC+, AAC, AMR-WB, AMR, WMA, WAV, OGG	MP3, WMA, M4A	MP3, eAAC+, AAC+, AAC, WMA	MP3, Protected AAC, AAC, Audible, Apple Lossless, AIFF, WAV	MP3, Protected AAC, AAC, Audible, Apple Lossless, AIFF, WAV
Camera Resolution (megapixels)	5+	2+	5+	8+	2+	3+
Auto-focus	Yes	No	Yes	Yes	No	Yes
Flash (type)	Yes (LED)	No	Yes (dual LED)	Yes (dual LED)	No	No
Touch-to-focus	Yes	No	No	No	No	Yes
Streaming Video	Yes	No	Yes	Yes	Yes	Yes
TV Output	Yes	No	Yes	Yes	Yes	Yes
Video Capture	720p HD	720p	720p HD	720p HD	No	VGA (640x480)
4G	No	No	No	No	No	No
Expandable Memory	No	Yes	No	Yes	No	No
Front Facing Camera	Yes	No	No	No	No	No
Keyboard	No	Yes	No	No	No	No
Speakerphone	Yes	Yes	Yes	Yes	Yes	Yes
NFC Capable	No	No	No	No	No	No
Dual Core processor	No	No	No	No	No	No

Exhibit E3. Top Smartphones

	Phones Identified by Other Sources							
	Apple iPhone 4S[4,5]	BlackBerry 8500 series (Curve 8520, 8530)[6]	BlackBerry 8300 Series (Curve 8310**, 8320, 8330, 8350i)[6]	BlackBerry Bold 9700[6]	HTC Amaze 4G[4]	HTC EVO 4G[2,3,5,7,8,9]	HTC Inspire 4G[5]	HTC myTouch 4G[8]
Platform	Apple	BlackBerry	BlackBerry	BlackBerry	Android	Android	Android	Android
Carrier(s)	Sprint, Verizon, AT&T	*discontinued*	*discontinued*	*discontinued*	T-Mobile	Sprint	AT&T	*discontinued*
Weight	4.9 oz	3.73 oz	3.9 oz	4.3 oz	6.1 oz	6 oz	5.78 oz	5 oz
Dimensions	4.5" x 2.31" x 0.37"	4.29" x 2.36" x 0.54"	4.2" x 2.4" x 0.6"	4.29" x 2.36" x 0.56"	5.12" x 2.58" x 0.46"	4.8" x 2.6" x 0.5"	4.8" x 2.68" x 0.46"	4.8" x 2.44" x 0.43"
Battery (max)	Talk: 8 hrs Standby: 200 hrs	Talk: 4.5 hrs Standby: 408 hrs	Talk: 4 hrs Standby: 408 hrs	Talk: 6 hrs Standby: 408 hrs	Talk: 6 hrs Standby: 264 hrs	Talk: 6 hrs Standby: 146 hrs	Talk: 6 hrs Standby: 372 hrs	Talk: 6 hrs Standby: 288 hrs
Display Type	LCD	LCD	LCD	LCD	LCD	LCD	LCD	LCD
Display Resolution	640x960	320x480	320x240	480x360	540x960	480x800	480x800	480x800
Screen Size (diagonal)	3.5 inches	2.6 inches	2.5 inches	2.4 inches	4.3 inches	4.3 inches	4.3 inches	3.8 inches
Colors	16.7 million (24-bit)	65,536	65,536	65,536	16 million	65,536 (16-bit)	16.7 million	65,536 (16-bit)
Processor	1000 MHz	512 MHz	312 MHz	624 MHz	1500 MHz	1000 MHz	1000 MHz	1000 MHz
Internal Storage	16 GB	133 MB	64 MB	128 MB	16 GB	440 MB	1 GB	1.2 GB
GPS/Location	Type: A-GPS supports LBS, navigation/plus compass/photo, video geo-tagging	No	Type: standalone GPS	Type: A-GPS supports LBS/includes BlackBerry Maps	Type: A-GPS w/ LBS, navigation/plus compass	Type: A-GPS supports LBS	Type: A-GPS	Type: A-GPS w/ LBS, navigation
Multiple Languages	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Vibrate	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bluetooth	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mobile Hotspot capable	Yes	No	No	No	Yes	Yes	Yes	No
Computer Sync	iTunes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
USB port type	supports charging	Yes	Yes	micro-USB connector	micro-USB connector	micro-USB connector	micro-USB connector	micro-USB connector
Wi-Fi	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Picture ID	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ringer ID	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Voice Dialing Type	speaker-independent (automatic) plus voice-controlled assistant and full dictation	speaker-independent (automatic)	speaker-independent (automatic)	speaker-independent (automatic)	speaker-independent (automatic)	speaker-independent (automatic)	speaker-independent (automatic)	speaker-independent (automatic)
Custom Graphics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Custom Ringtones	via iTunes only	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Real-Music Ringers	via iTunes only	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Data Tethering capable	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Predictive Text Entry	Yes	Yes	Yes	Yes	Yes (T9 Trace)	Yes (Swype)	Yes (T9)	Yes (Swype)
Touch Screen Type	Capacitive multi-touch	No	No	No	Capacitive	Capacitive	Capacitive multi-touch	Capacitive
Email Client protocols supported	POP, IMAP, Exchange built-in attachment viewer (Microsoft Office, PDF)	push, attachments	POP3, IMAP, SMTP, Exchange, Lotus Domino, Blackberry Connect	POP3, IMAP, Exchange, push/supports attachments (Word, Excel, PowerPoint, PDF) and secure email	POP, IMAP, Gmail, Exchange	POP, IMPA, Exchange, Gmail	POP, IMAP, Gmail, Exchange	POP, IMAP, Gmail, Exchange
MMS	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Music Player Supported Formats	MP3, Protected AAC, AAC, Audible, Apple Lossless, AIFF, WAV	MP3, eAAC+, AAC+, AAC, AMR, WMA, WAV	MP3, eAAC+, AAC+, AAC, AMR, WMA, WAV	MIDI, MP3, eAAC+, AAC+, AAC, AMR, WMA Pro, WMA	MP3, MP4, AAC+, WMA, WAV	MIDI, MP3, AAC, AMR, WMA, WAV	MIDI, MP3, AAC, AMR, WMA, WAV, M4A, OGG	MIDI, MP3, AAC+, AAC, WMA, WAV, OGG
Camera Resolution (megapixels)	8+	2+	2+	3+	8+	8+	8+	5+
Auto-focus	Yes	No	No	Yes	No	Yes	Yes	Yes
Flash (type)	Yes (LED)	No	Yes (LED)	Yes (LED)	Yes (LED)	Yes (LED)	Yes (dual LED)	Yes (LED)
Touch-to-focus	Yes	No	No	No	No	No	No	No
Streaming Video	Yes	No	No	Yes	Yes	Yes	Yes	Yes
TV Output	Yes	No	No	No	Yes (HDMI via MHL)	Yes (HDMI)	No	No
Video Capture	1080p HD	QVGA (320x240)	No	480x360	1080p HD	720p HD	720p HD	720p HD
4G	No	No	No	No	Yes	Yes	Yes	Yes
Expandable Memory	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Front Facing Camera	Yes	No	No	No	Yes	Yes	No	Yes
Keyboard	No	Yes	Yes	Yes	No	No	No	No
Speakerphone	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NFC Capable	No	No	No	No	Yes	No	No	No
Dual Core processor	Yes	No	No	No	Yes	No	No	No

Exhibit E3. Top Smartphones

	Phones Identified by Other Sources							
	HTC Radar 4G[4]	**HTC Thunderbolt**[7]	**LG G2 X 4G**[3,7]	**Motorola Droid**[6]	**Motorola Droid 2 Global**[8]	**Motorola Droid 3**[2]	**Motorola Droid Bionic**[5]	**Motorola Droid Razr**[4]
Platform	Windows	Android	Android	Android	Android	Android	Android	Android
Carrier(s)	T-Mobile	Verizon	T-Mobile	*discontinued*	*discontinued*	Verizon Wireless	Verizon	Verizon
Weight	4.83 oz	5.78 oz	5 oz	5.99 oz	6.1 oz	6.49 oz	5.6 oz	4.48 oz
Dimensions	4.7" x 2.4" x 0.43"	4.8" x 2.6" x 0.52"	4.88" x 2.48" x 0.43"	4.55" x 2.35" x 0.55"	4.58" x 2.38" x 0.54"	4.85" x 2.52" x 0.51"	5" x 2.63" x 0.43"	5.15" x 2.71" x 0.28"
Battery (max)	Talk: 7.7 hrs Standby: 575 hrs	Talk: 6.3 hrs Standby: 312 hrs	Talk: 7 hrs Standby: 288 hrs	Talk: 6.4 hrs Standby: 270 hrs	Talk: 8.3 hrs Standby: 230 hrs	Talk: 9.2 hrs Standby: 300 hrs	Talk: 10.8 hrs Standby: 200 hrs	Talk: 12.5 hrs Standby: 204 hrs
Display Type	LCD	LCD	LCD	LCD	LCD	LCD	LCD	OLED
Display Resolution	480x800	480x800	480x800	480x854	480x854	540x960	540x960	540x960
Screen Size (diagonal)	3.8 inches	4.3 inches	4 inches	3.7 inches	3.7 inches	4 inches	4.3 inches	4.3 inches
Colors	16 million	16 million	16.7 million (24-bit)	16.7 million	16.7 million (24-bit)	16 million	16.7 million	16.7 million
Processor	1000 MHz	1000 MHz	1000 MHz	550 MHz	1200 Mhz	1000 MHz	1000 MHz	1200 MHz
Internal Storage	8 GB	8 GB	5.4 GB	256 MB	8 GB	16 GB	12 GB	16 GB
GPS/Location	Type: A-GPS w/ LBS, navigation	Type: A-GPS w/ LBS, navigation	Type: A-GPS	Type: A-GPS supports LBS/navigation w/ turn-by-turn driving directions	Type: A-GPS w/ LBS, navigation/plus compass	Type: A-GPS, S-GPS	Type: A-GPS w/ LBS, navigation/plus compass	Type: A-GPS
Multiple Languages	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Vibrate	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bluetooth	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mobile Hotspot capable	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Computer Sync	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
USB port type	micro-USB connector	micro-USB connector	micro-USB connector	micro-USB connector	micro-USB connector	micro-USB connector	micro-USB connector	micro-USB connector
Wi-Fi	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Picture ID	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ringer ID	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Voice Dialing Type	speaker-independent (automatic)	speaker-independent (automatic)	speaker-independent (automatic)	speaker-independent (automatic)	speaker-independent (automatic)	speaker-independent (automatic)	speaker-independent (automatic)	speaker-independent (automatic)
Custom Graphics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Custom Ringtones	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Real-Music Ringers	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Data Tethering capable	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Predictive Text Entry		Yes	Yes (Swype)	Yes	Yes (Swype)	Yes (Swype)	Yes (Swype)	Yes (Swype)
Touch Screen Type	Capacitive multi-touch	Capacitive multi-touch, haptics	Capacitive	Capacitive	Capacitive multi-touch	Capacitive	Capacitive	Capacitive
Email Client protocols supported	POP, IMAP, Exchange, Push	POP, IMAP, Gmail, Exchange	POP, IMAP, Gmail, Exchange	IMAP, POP, SMTP, Exchange, unified inbox/plus Gmail client	POP, IMAP, Gmail, Exchange	POP, IMPAP, Gmail, Exchange	POP, IMAP, Gmail, Exchange	POP, IMAP, Gmail, Exchange
MMS	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Music Player Supported Formats	MP3, WMA, M4A	MIDI, MP3, AAC, AMR, WMA, WAV, M4A, OGG	MIDI, MP3, AAC+, AAC, WMA, WAV	MP3, AAC+, AAC, WMA	MP3, eAAC, AAC+, AAC, OGG	MIDI, MP3, eAAC+, AAC+, AAC, WAV, QCP	MIDI, MP3, eAAC+, AAC+, AAC	MIDI, MP3, eAAC+, AAC+, AAC, AMR, WMA, WAV
Camera Resolution (megapixels)	5+	8+	8+	5+	5+		8+	8+
Auto-focus	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Flash (type)	Yes (dual LED)	Yes (dual-LED)	Yes (LED)	Yes (LED)	Yes (dual-LED)	Yes (LED)	Yes (LED)	Yes (LED)
Touch-to-focus	No	Yes	No	No	No	Yes	No	No
Streaming Video	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TV Output	No	No	Yes (HDMI)	No	No	Yes (HDMI)	Yes	Yes (HDMI)
Video Capture	720p HD	720p HD	1080p HD	WVGA/480p	WVGA/480p	1080p HD	1080p HD	1080p HD
4G	Yes	Yes	Yes	No	No	No	Yes	Yes
Expandable Memory	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Front Facing Camera	Yes	Yes	Yes	No	No	Yes	Yes	Yes
Keyboard	No	No	No	Yes	Yes	Yes	No	No
Speakerphone	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NFC Capable	No	No	No	No	No	No	No	No
Dual Core processor	No	No	Yes	No	No	Yes	Yes	Yes

Exhibit E3. Top Smartphones

	Phones Identified by Other Sources							
	Motorola Droid X[8,9]	Samsung Epic 4G[4,5,7]	Samsung Galaxy Nexus[4]	Samsung Galaxy S 4G[5]	Samsung Galaxy S II (AT&T)[4, maybe 5]	Samsung Galaxy S II (T-Mobile)[4, maybe 5]	Samsung Infuse 4G[3]	Samsung Nexus S[3]
Platform	Android	Android	Android	Android	Android	Android	Android	Android
Carrier(s)	*discontinued*	Sprint	Verizon	T-Mobile	AT&T	T-Mobile	AT&T	T-Mobile, AT&T
Weight	5.47 oz	5.46 oz	5.13 oz	4.16 oz	4.3 oz	4.77 oz	4.9 oz	4.55 oz
Dimensions	5" x 2.6" x 0.4"	4.91" x 2.54" x 0.56"	5.33" x 2.67" x 0.37"	4.82" x 2.54" x 0.39"	4.96" x 2.6" x 0.35"	5.11" x 2.71" x 0.37"	5.2" x 2.8" x 0.35"	4.88" x 2.48" x 0.43"
Battery (max)	Talk: 8 hrs Standby: 220 hrs	Talk: 6 hrs Standby: 300 hrs	Talk: 12 hrs Standby: 150 hrs	Talk: 6.5 hrs Standby: 400 hrs	Talk: 8 hrs Standby: 400 hrs	Talk: 7hrs Standby: 167 hrs	Talk: 8 hrs Standby: 400 hrs	Talk: 6.7 hrs Standby: 427 oz
Display Type	LCD	OLED	OLED	OLED	OLED	OLED	OLED	OLED
Display Resolution	480x854	480x800	720x1800	480x800	480x800	480x800	480x800	480x800
Screen Size (diagonal)	4.3 inches	4 inches	4.7 inches	4 inches	4.3 inches	4.5 inches	4.5 inches	4 inches
Colors	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million (24-bit)	16.7 million	16.7 million (24-bit)	16.7 million
Processor	1000 MHz	1200 MHz	1200 MHz	1000 MHz	1200 MHz	1500 MHz	1200 MHz	1000 MHz
Internal Storage	8 GB	16 GB	32 GB	16 GB	16 GB	16 GB	13 GB	16 GB
GPS/Location	Type: A-GPS w/ LBS, navigation	Type: A-GPS supports LBS / navigation	Type: A-GPS	Type: A-GPS w/ LBS, turn-by-turn navigation	Type: A-GPS	Type: A-GPS	Type: A-GPS supports LBS, navigation	Type: A-GPS supports LBS, navigation, turn-by-turn directions
Multiple Languages	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Vibrate	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bluetooth	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mobile Hotspot capable	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Computer Sync	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
USB port type	micro-USB connector	micro-USB connector	micro-USB connector	micro-USB connector	micro-USB connector	micro-USB connector	micro-USB connector	micro-USB connector
Wi-Fi	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Picture ID	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ringer ID	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Voice Dialing Type	speaker-independent (automatic)	speaker-independent (automatic)	speaker-independent (automatic)	speaker-independent (automatic)	speaker-independent (automatic)	speaker-independent (automatic)	speaker-independent (automatic)	speaker-independent (automatic)
Custom Graphics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Custom Ringtones	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Real-Music Ringers	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Data Tethering capable	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Predictive Text Entry	Yes (Swype)	Yes (Swype)	Yes	Yes (Swype)	Yes (Swype)	Yes (Swype)	Yes (Swype)	Yes
Touch Screen Type	Capacitive	Capacitive	Capacitive	Capacitive	Capacitive	Capacitive	Capacitive multi-touch	Capacitive
Email Client protocols supported	IMAP4, POP3, SMTP, Gmail	POP, IMAP, Gmail, Exchange	POP, IMAP, Gmail, Exchange	POP, IMAP, Gmail, Exchange	POP, IMAP, Gmail, Exchange	Exchange, Gmail	POP, IMPA, Exchange, Gmail	POP, IMPA, Exchange, Gmail
MMS	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Music Player Supported Formats	MP3, AAC+, AAC, WMA, WAV	MIDI, MP3, AAC+, AAC, AMR, WMA	MP3, eAAC+, AAC+, AAC	MIDI, MP3, eAAC+, AAC+, AAC, WMA, WAV, OGG	MIDI, MP3, AAC, AMR-WB, WMA, WAV, AMR-NB	MP3, MP4, eAAC+, WAV	MIDI, MP3, AAC+, AAC, WMA, WAV	MIDI, MP3, AAC+, AAC, AMR, WMA, WAV, OGG
Camera Resolution (megapixels)	8+	5+	5+	5+	8+	8+	8+	5+
Auto-focus	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Flash (type)	Yes (dual-LED)	Yes (LED)	Yes (LED)	No	Yes (LED)	Yes (LED)	Yes (LED)	Yes (LED)
Touch-to-focus	Yes	Yes	No	Yes	No	No	No	No
Streaming Video	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TV Output	Yes (HDMI)	No	Yes (HDMI)	Yes	Yes (HDMI)	Yes (HDMI plus DLNA)	Yes (HDMI via MHL)	No
Video Capture	720p HD	720p HD	1080p HD	720p HD	1080p HD	1080p HD	720p HD	WVGA/480p
4G	No	Yes	Yes	Yes	Yes	Yes	Yes	No
Expandable Memory	Yes	Yes	No	Yes	Yes	Yes	Yes	No
Front Facing Camera	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Keyboard	No	Yes	No	No	No	No	No	No
Speakerphone	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NFC Capable	No	No	Yes	No	Yes	Yes	No	Yes
Dual Core processor	No	No	Yes	No	Yes	Yes	No	No

Exhibit E3. Top Smartphones Feature Comparison

Notes/Assumptions:
When not explicitly stated otherwise, used 16 GB iPhone to match Shugan.
When not explicitly stated, "iPhone" assumed to be iPhone 4.
Carrier information found using http://www.phonescoop.com.
Blackberry Curve specifications used for the model Curve 8520.
Certain features not included due to congruency across all phones (including but not limited to: camera, flight mode, SMS text messaging, headphone jack, alarm, calculator, calendar, games).
Certain features not included due to lack of weight on purchase decision (including but not limited to: hearing aid compatibility, adjustable text size, spectrum modes, slide keys, browser type).
Price not included as metric due to variations that arise for phones depending on carrier and/or contract duration.
Source [4] used to find all music player supported format information.

Sources Used to Identify Phones:
[1] Shugan Expert Report.
[2] The NPD Group, Consumer Tracking Service, Mobile Phone Track, *Q3 2011 Top 5 Handsets* , Q3 2011.
[3] Rodman & Renshaw, *May U.S. Cellular Handset Survey* , May 2011.
[4] Cannaccord Genuity, *Monthly Channel Checks* , December 2011.
[5] The NPD Group/Retail Tracking Service, *CES 2012 Media Fact Sheet* , 2012.
[6] Nielsen, *The Top Trends for 2010* , December 22, 2010.
[7] Hudson Securities, *April U.S. Cellular Handset Survey* , April 2011.
[8] Hudson Securities, *December 2010 U.S. Cellular Survey,* December 2010.
[9] The NPD Group, Mobile Phone Track, Q1 2011.

Sources Used to Identify Phone Attributes:
http://www.phonescoop.com
http://www.phonearena.com
http://www.gsmarena.com
http://www.cellphones.ca/
http://cellphoneforums.net
http://www.mobilemag.com/2010/09/24/review-blackberry-curve-3g-9300/

Exhibit E4. Distribution of Time Spent on Instructions Page

Time Spent on Instructions Page (in seconds)	Percentage of Respondents	Cumulative Percentage
<5	20.7%	20.7%
5-10	21.9%	42.6%
10-15	11.2%	53.8%
15-20	8.7%	62.5%
20-25	7.0%	69.5%
25-30	5.5%	75.0%
30-35	3.2%	78.2%
35-40	5.6%	83.8%
40-45	3.6%	87.4%
45-50	2.3%	89.7%
50-55	1.9%	91.6%
55-60	0.6%	92.2%
>60	7.8%	100.0%

Exhibit E5
Percentiles for Distribution of Time Spent by Choice Task

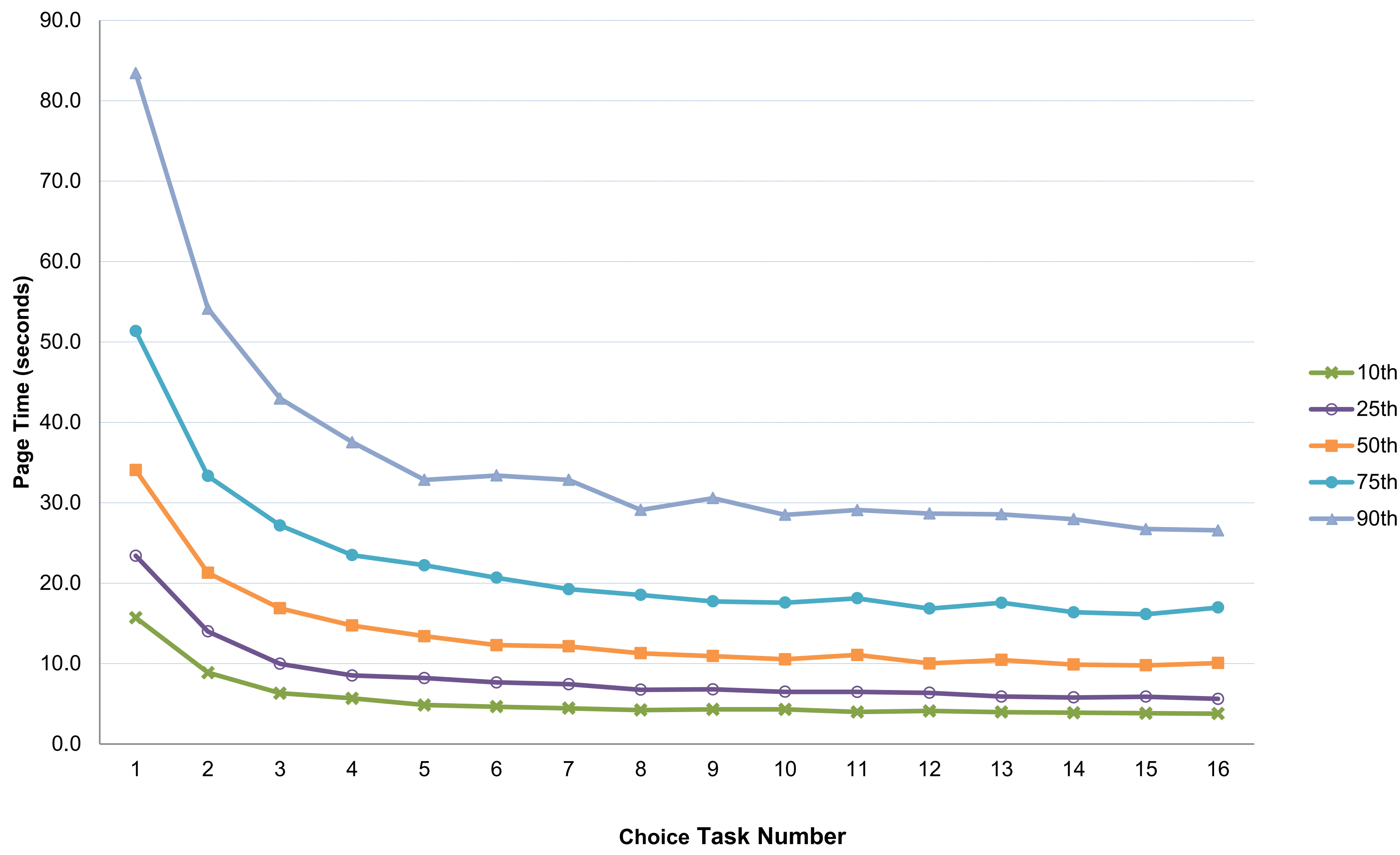

Exhibit E6. Determinants of Time Spent on Choice Question, Ordinary Least Squares Regression

Explanatory Variable	[1]	[2]	[3]	[4]	[5]
Difference in utility between most preferred and second most preferred options	-0.991	-0.955	-0.491		
	[0.078]*	[0.075]*	[0.106]*		
Difference in utility between most preferred and least preferred options				-0.378	
				[0.079]*	
Variance in utility across all options					-0.083
					[0.020]*
Constant	23.202	18.354	16.377	17.708	15.820
	[0.425]*	[0.973]*	[0.926]*	[1.081]*	[0.892]*
Question Fixed Effects					
Task 1		30.570	30.408	30.367	30.393
		[1.282]*	[1.123]*	[1.123]*	[1.123]*
Task 2		12.793	12.620	12.575	12.600
		[1.286]*	[1.125]*	[1.125]*	[1.125]*
Task 3		7.629	7.726	7.607	7.612
		[1.294]*	[1.131]*	[1.131]*	[1.131]*
Task 4		5.783	5.680	5.626	5.642
		[1.289]*	[1.127]*	[1.126]*	[1.127]*
Task 5		3.839	3.770	3.626	3.660
		[1.287]*	[1.126]*	[1.126]*	[1.126]*
Task 6		2.961	2.865	2.815	2.815
		[1.293]*	[1.129]*	[1.129]*	[1.130]*
Task 7		3.190	2.988	2.851	2.847
		[1.290]*	[1.127]*	[1.127]*	[1.127]*
Task 8		2.045	1.872	1.704	1.727
		[1.287]	[1.125]+	[1.125]	[1.125]
Task 9		1.179	0.739	0.586	0.569
		[1.290]	[1.129]	[1.129]	[1.129]
Task 10		0.589	0.385	0.212	0.236
		[1.286]	[1.124]	[1.124]	[1.124]
Task 11		1.219	1.120	0.987	1.004
		[1.286]	[1.123]	[1.123]	[1.123]
Task 12		1.529	1.338	1.249	1.275
		[1.296]	[1.132]	[1.132]	[1.133]
Task 13		0.573	0.406	0.350	0.355
		[1.300]	[1.136]	[1.136]	[1.136]
Task 14		-0.008	0.085	-0.059	-0.077
		[1.289]	[1.127]	[1.126]	[1.127]
Task 15		0.172	0.326	0.210	0.231
		[1.296]	[1.132]	[1.132]	[1.132]
Respondent Fixed Effects	No	No	Yes	Yes	Yes
R squared	0.010	0.100	0.370	0.370	0.370

Notes:
1. In all regressions, page time for a choice question is the dependent variable.
2. All regressions have 12500 observations, excluding 28 observations with a page time that is over 500 seconds.
3. Standard errors are in brackets. + and * denote statistical significance at the 10% and 5% level, respectively.

Exhibit E7. Sensitivity Analysis of Preference Estimation, Estimated Mean Partworths

	Operating System Brand				Screen Size (inch)			Price ($)			Voice Commands			Multitasking (# apps)			Application Availability (# apps)				App Startup Time (sec)		
	Android	Apple	BB	Windows	3.5	4.0	4.5	300	200	100	None	Dialing	Texting	1	Up to 5	Up to 9	6,000	40,000	100,000	300,000	4	2	0.2
Prof. Shugan's Base Case	0.718	0.861	-1.048	-0.531	-0.593	0.154	0.439	-1.734	0.295	1.439	-0.806	-0.181	0.987	-1.087	0.531	0.556	-0.620	-0.078	0.307	0.390	-0.942	0.218	0.724
Excluding Potentially Unreliable Responses																							
Page time on instructions < 10 seconds	0.743	0.973	-1.065	-0.652	-0.867	0.212	0.655	-2.520	0.409	2.111	-1.168	-0.063	1.231	-1.704	0.854	0.850	-0.819	-0.063	0.475	0.408	-1.433	0.368	1.065
Page time on choice task < 5 seconds	0.810	0.843	-1.098	-0.555	-0.653	0.159	0.494	-1.911	0.353	1.558	-0.878	-0.183	1.061	-1.223	0.583	0.640	-0.667	-0.053	0.346	0.374	-1.094	0.244	0.849
Page time on choice task < 10 seconds	0.866	0.710	-1.050	-0.525	-0.813	0.253	0.560	-2.142	0.442	1.700	-0.998	-0.188	1.186	-1.437	0.681	0.757	-0.753	0.008	0.380	0.365	-1.237	0.290	0.947
< 3 minutes to complete survey[1]	0.730	0.841	-1.037	-0.534	-0.608	0.144	0.464	-1.816	0.312	1.504	-0.843	-0.185	1.028	-1.146	0.559	0.587	-0.624	-0.091	0.314	0.402	-0.995	0.225	0.770
Entered survey more than once[2]	0.781	0.862	-1.126	-0.516	-0.581	0.153	0.428	-1.777	0.326	1.451	-0.798	-0.172	0.970	-1.132	0.547	0.585	-0.610	-0.089	0.296	0.402	-0.953	0.211	0.742
< 5 minutes to complete survey or entered survey more than once	0.827	0.651	-1.020	-0.458	-0.697	0.163	0.534	-2.126	0.417	1.709	-0.995	-0.113	1.108	-1.430	0.703	0.726	-0.746	-0.055	0.363	0.438	-1.185	0.282	0.903
Alternative Estimation Techniques																							
Including Choice Tasks with "None" Option Selected	0.751	0.850	-1.082	-0.519	-0.617	0.163	0.454	-1.732	0.312	1.420	-0.783	-0.231	1.014	-1.157	0.542	0.615	-0.568	-0.071	0.259	0.380	-0.984	0.256	0.728
Simple Logit*	0.292	0.413	-0.365	-0.340	-0.181	0.034	0.146	-0.502	0.035	0.467	-0.239	-0.089	0.329	-0.327	0.154	0.173	-0.171	-0.030	0.084	0.117	-0.271	0.045	0.227
Excluding Respondents with Potentially Different Underlying Preferences																							
Possibly employer-constrained																							
Phone provided by employer[3]	0.776	0.874	-1.145	-0.504	-0.613	0.180	0.433	-1.742	0.279	1.463	-0.821	-0.171	0.992	-1.085	0.526	0.558	-0.611	-0.056	0.303	0.364	-0.912	0.222	0.690
Phone options constrained by employer[4]	0.800	0.882	-1.137	-0.545	-0.625	0.161	0.463	-1.798	0.312	1.486	-0.830	-0.184	1.014	-1.094	0.528	0.565	-0.631	-0.064	0.300	0.395	-0.936	0.219	0.718
Any of the above, or phone used for work	0.763	1.209	-1.242	-0.729	-0.763	0.152	0.610	-2.256	0.372	1.884	-0.936	-0.360	1.296	-1.267	0.698	0.569	-0.784	0.028	0.394	0.362	-1.053	0.330	0.723
Choose same operating system brand in all choice tasks	0.773	0.348	-0.776	-0.344	-0.638	0.168	0.469	-1.914	0.318	1.596	-0.893	-0.181	1.074	-1.202	0.583	0.619	-0.622	-0.078	0.317	0.383	-1.012	0.226	0.786
Intend to purchase smartphone within next six months	0.851	0.850	-1.130	-0.571	-0.701	0.155	0.546	-1.911	0.298	1.614	-0.863	-0.247	1.110	-1.227	0.587	0.640	-0.640	-0.093	0.310	0.423	-0.989	0.172	0.817
Eliminating Inconsistent Economic Preferences																							
Excluding respondents who prefer…																							
a higher price[5]	0.715	0.980	-1.142	-0.553	-0.712	0.192	0.519	-2.667	0.231	2.436	-0.754	-0.180	0.934	-1.174	0.577	0.597	-0.645	-0.098	0.360	0.383	-1.066	0.259	0.808
a slower application startup time[6]	0.821	1.445	-1.425	-0.840	-0.887	0.184	0.704	-2.016	0.368	1.648	-1.047	-0.057	1.104	-1.472	0.675	0.798	-0.756	-0.133	0.306	0.583	-1.873	0.201	1.672
a higher price or a slower app startup time[7]	0.715	1.586	-1.456	-0.846	-0.955	0.128	0.827	-2.953	0.295	2.659	-0.987	-0.129	1.116	-1.497	0.669	0.828	-0.874	-0.090	0.361	0.604	-1.948	0.218	1.730
less application availability	0.680	3.417	-2.563	-1.535	-0.766	0.230	0.536	-1.887	0.412	1.475	-0.764	0.064	0.701	-1.706	0.647	1.059	-1.824	-0.712	0.563	1.974	-1.556	0.119	1.437
less multitasking	0.722	0.334	-0.633	-0.423	-0.758	0.275	0.484	-2.271	0.318	1.953	-1.308	-0.331	1.639	-2.072	0.379	1.693	-0.882	-0.304	0.567	0.619	-1.298	0.220	1.078
less voice command functionality	0.621	1.434	-1.406	-0.650	-0.741	0.173	0.568	-1.928	0.391	1.538	-2.010	-0.063	2.073	-1.379	0.654	0.726	-0.688	-0.082	0.493	0.277	-1.019	0.210	0.809
Modeling monotonic preferences in…																							
price[8]	0.686	0.822	-1.011	-0.497	-0.597	0.153	0.444	-1.043	1.806	-0.763	-0.767	-0.178	0.945	-1.079	0.521	0.559	-0.575	-0.078	0.288	0.365	-0.938	0.221	0.717
all attributes except brand and screen size	0.619	0.605	-0.800	-0.424	-0.501	0.131	0.370	-0.974	1.258	-0.284	2.271	-0.041	-2.230	0.684	0.831	-1.515	-0.129	0.262	1.348	-1.481	2.298	0.432	-2.729

Note:
* The simple logit results reported in this exhibit differ from the results reported in Exhibits [[10a]] through [[10c]] because the variables in this exhibit are effects-coded, while the variables in Exhibits [[9a]] through [[9c]] are dummy-coded.

Sources:
[1] Shugan Expert Report, FonKN_B_summary.txt.
[2] Shugan Expert Report, FonKN_RPS_summary.txt.
[3] Shugan Expert Report, FonKN_C_summary.txt.
[4] Shugan Expert Report, FonKN_D_summary.txt.
[5] Shugan Expert Reply Report, FonKN_PRP_summary.txt.
[6] Shugan Expert Reply Report, FonKN_PRAST_summary.txt.
[7] Shugan Expert Reply Report, FonKN_PRB_summary.txt.
[8] Shugan Expert Reply Report, FonKN_P_summary.txt.

Exhibit E8a. Sensitivity Analysis of Relative Value between Availability of Applications and Application Startup Time

Averaging Partworth Ranges/Differences Across Respondents Before Calculating Relative Percentages

	Prof. Shugan's Relative Importance Estimates Based on Partworth Ranges								Relevant Relative Importance Based on Partworth Differences between Actual and But-For Levels Per Shugan			Relevant Relative Importance Based on Partworth Differences between Actual and But-For Levels Per Cockburn		
	Operating System Brand [a]	Price [b]	Voice Commands [c]	Multi-tasking [d]	Application Startup Time [e]	Application Availability [f]	Screen Size [g]	Ratio of App. Avail. to App. Startup Time [h]=[f]/[e]	Application Startup Time [i]	Application Availability [j]	Ratio of App. Avail. to App. Startup Time [k]=[j]/[i]	Application Startup Time [l]	Application Availability [m]	Ratio of App. Avail. to App. Startup Time [n]=[m]/[l]
Prof. Shugan's Base Case	29.16%	19.98%	13.13%	11.47%	11.17%	7.85%	7.24%	0.70	69.67%	30.33%	0.44	64.48%	35.52%	0.55
Excluding Potentially Unreliable Responses														
Page time on instructions < 10 seconds	22.91%	21.95%	13.93%	13.21%	12.32%	7.99%	7.68%	0.65	71.80%	28.20%	0.39	65.36%	34.64%	0.53
Page time on choice task < 5 seconds	26.71%	20.38%	13.74%	11.96%	11.92%	7.76%	7.53%	0.65	71.51%	28.49%	0.40	65.50%	34.50%	0.53
Page time on choice task < 10 seconds	21.48%	21.37%	14.41%	13.56%	12.54%	8.11%	8.52%	0.65	74.99%	25.01%	0.33	65.32%	34.68%	0.53
< 3 minutes to complete survey[1]	28.08%	20.31%	13.40%	11.77%	11.40%	7.69%	7.35%	0.67	70.50%	29.50%	0.42	65.37%	34.63%	0.53
Entered survey more than once[2]	29.66%	20.03%	12.92%	11.67%	11.06%	7.68%	6.98%	0.69	69.75%	30.25%	0.43	65.18%	34.82%	0.53
< 5 minutes to complete survey or entered survey more than once	24.25%	21.22%	13.94%	13.10%	12.10%	7.97%	7.42%	0.66	72.16%	27.84%	0.39	100.00%	53.76%	0.54
Alternative Estimation Techniques														
Including Choice Tasks with "None" Option Selected	28.39%	19.82%	13.49%	11.95%	11.47%	7.47%	7.41%	0.65	71.68%	28.32%	0.40	66.81%	33.19%	0.50
Simple Logit*	19.81%	24.67%	14.46%	12.73%	12.68%	7.32%	8.33%	0.58	73.43%	26.57%	0.36	66.12%	33.88%	0.51
Excluding Respondents with Potentially Different Underlying Preferences														
Possibly employer-constrained														
Phone provided by employer[3]	29.75%	19.99%	13.26%	11.41%	10.73%	7.61%	7.25%	0.71	70.21%	29.79%	0.42	64.33%	35.67%	0.55
Phone options constrained by employer[4]	29.48%	20.06%	13.26%	11.36%	10.88%	7.68%	7.28%	0.71	70.48%	29.52%	0.42	64.58%	35.42%	0.55
Any of the above, or phone used for work	26.64%	21.32%	14.38%	11.38%	9.88%	8.47%	7.94%	0.86	68.67%	31.33%	0.46	60.35%	39.65%	0.66
Choose same operating system brand in all choice tasks	21.03%	22.56%	14.97%	12.90%	12.34%	8.17%	8.03%	0.66	70.05%	29.95%	0.43	65.78%	34.22%	0.52
Intend to purchase smartphone within next six months	27.87%	20.20%	13.37%	11.95%	10.74%	7.88%	8.01%	0.73	65.51%	34.49%	0.53	64.15%	35.85%	0.56
Eliminating Inconsistent Economic Preferences														
Excluding respondents who prefer…														
a higher price[5]	28.73%	25.23%	11.04%	10.66%	10.33%	6.92%	7.09%	0.67	69.71%	30.29%	0.43	64.47%	35.53%	0.55
a slower application startup time[6]	28.71%	17.16%	11.91%	11.51%	15.65%	7.32%	7.73%	0.47	76.11%	23.89%	0.31	75.36%	24.64%	0.33
a higher price or a slower app startup time[7]	28.18%	21.88%	10.38%	10.59%	14.33%	7.11%	7.52%	0.50	75.69%	24.31%	0.32	73.46%	26.54%	0.36
less application availability	41.28%	12.09%	6.98%	10.37%	11.17%	12.97%	5.14%	1.16	60.09%	39.91%	0.66	57.16%	42.84%	0.75
less multitasking	20.16%	19.85%	15.27%	16.57%	12.28%	8.63%	7.24%	0.70	64.86%	35.14%	0.54	64.18%	35.82%	0.56
less voice command functionality	31.05%	16.64%	18.19%	11.04%	9.29%	6.92%	6.87%	0.75	63.58%	36.42%	0.57	61.40%	38.60%	0.63
Modeling monotonic preferences in…														
price[8]	28.12%	21.80%	12.76%	11.41%	11.12%	7.53%	7.26%	0.68	70.40%	29.60%	0.42	65.62%	34.38%	0.52
all attributes except brand and screen size	25.00%	21.18%	14.31%	12.72%	12.29%	7.49%	7.01%	0.61	76.44%	23.56%	0.31	68.48%	31.52%	0.46
Summary Statistics														
Minimum	19.81%	12.09%	6.98%	10.37%	9.29%	6.92%	5.14%	0.47	60.09%	23.56%	0.31	57.16%	24.64%	0.33
Maximum	41.28%	25.23%	18.19%	16.57%	15.65%	12.97%	8.52%	1.16	76.44%	39.91%	0.66	100.00%	53.76%	0.75
Median	28.10%	20.35%	13.44%	11.72%	11.43%	7.68%	7.38%	0.67	70.44%	29.56%	0.42	65.34%	34.75%	0.53
Mean	27.11%	20.44%	13.34%	12.06%	11.71%	7.93%	7.40%	0.69	70.33%	29.67%	0.43	66.98%	35.47%	0.53
Standard Deviation	4.63%	2.68%	2.10%	1.33%	1.40%	1.21%	0.67%	0.13	4.07%	4.07%	0.09	8.27%	5.53%	0.09

Exhibit E8b. Sensitivity Analysis of Relative Value between Availability of Applications and Application Startup Time
Averaging Relative Percentages Across Respondents

	Prof. Shugan's Relative Importance Estimates Based on Partworth Ranges								Relevant Relative Importance Based on Partworth Differences between Actual and But-For Levels Per Shugan			Relevant Relative Importance Based on Partworth Differences between Actual and But-For Levels Per Cockburn		
	Operating System Brand	Price	Voice Commands	Multi-tasking	Application Startup Time	Application Availability	Screen Size	Ratio of App. Avail. to App. Startup Time	Application Startup Time	Application Availability	Ratio of App. Avail. to App. Startup Time	Application Startup Time	Application Availability	Ratio of App. Avail. to App. Startup Time
	[a]	[b]	[c]	[d]	[e]	[f]	[g]	[h]=[f]/[e]	[i]	[j]	[k]=[j]/[i]	[l]	[m]	[n]=[m]/[l]
Prof. Shugan's Base Case	30.10%	19.28%	13.21%	11.12%	10.93%	8.01%	7.36%	0.73	65.57%	34.43%	0.53	59.03%	40.97%	0.69
Excluding Potentially Unreliable Responses														
Page time on instructions < 10 seconds	23.99%	21.15%	14.13%	12.79%	12.20%	8.04%	7.69%	0.66	67.67%	32.33%	0.48	60.66%	39.34%	0.65
Page time on choice task < 5 seconds	27.73%	19.71%	13.85%	11.62%	11.67%	7.84%	7.58%	0.67	66.42%	33.58%	0.51	60.94%	39.06%	0.64
Page time on choice task < 10 seconds	22.70%	20.75%	14.35%	13.19%	12.37%	8.10%	8.54%	0.66	70.94%	29.06%	0.41	61.51%	38.49%	0.63
< 3 minutes to complete survey[1]	29.09%	19.59%	13.53%	11.39%	11.12%	7.81%	7.47%	0.70	65.73%	34.27%	0.52	60.02%	39.98%	0.67
Entered survey more than once[2]	30.51%	19.33%	13.04%	11.29%	10.87%	7.85%	7.12%	0.72	65.70%	34.30%	0.52	60.25%	39.75%	0.66
< 5 minutes to complete survey or entered survey more than once	25.47%	20.39%	14.03%	12.66%	11.83%	8.10%	7.51%	0.68	67.52%	32.48%	0.48	60.05%	39.95%	0.67
Alternative Estimation Techniques														
Including Choice Tasks with "None" Option Selected	29.49%	19.20%	13.51%	11.42%	11.19%	7.68%	7.50%	0.69	66.18%	33.82%	0.51	60.36%	39.64%	0.66
Simple Logit*	19.81%	24.67%	14.46%	12.73%	12.68%	7.32%	8.33%	0.58	73.43%	26.57%	0.36	66.12%	33.88%	0.51
Excluding Respondents with Potentially Different Underlying Preferences														
Possibly employer-constrained														
Phone provided by employer[3]	30.49%	19.39%	13.42%	11.08%	10.53%	7.77%	7.32%	0.74	66.09%	33.91%	0.51	59.52%	40.48%	0.68
Phone options constrained by employer[4]	30.20%	19.52%	13.37%	11.06%	10.62%	7.86%	7.36%	0.74	66.14%	33.86%	0.51	59.41%	40.59%	0.68
Any of the above, or phone used for work	27.63%	20.47%	14.55%	10.96%	9.83%	8.66%	7.90%	0.88	66.17%	33.83%	0.51	57.78%	42.22%	0.73
Choose same operating system brand in all choice tasks	21.91%	21.76%	15.15%	12.54%	12.08%	8.37%	8.19%	0.69	64.94%	35.06%	0.54	59.68%	40.32%	0.68
Intend to purchase smartphone within next six months	28.64%	19.58%	13.45%	11.57%	10.59%	8.03%	8.15%	0.76	60.86%	39.14%	0.64	59.97%	40.03%	0.67
Eliminating Inconsistent Economic Preferences														
Excluding respondents who prefer…														
a higher price[5]	29.47%	24.89%	11.08%	10.23%	10.16%	7.02%	7.15%	0.69	65.09%	34.91%	0.54	60.36%	39.64%	0.66
a slower application startup time[6]	29.18%	16.79%	11.95%	11.10%	15.73%	7.46%	7.79%	0.47	74.44%	25.56%	0.34	75.03%	24.97%	0.33
a higher price or a slower app startup time[7]	28.55%	21.71%	10.53%	10.20%	14.32%	7.19%	7.50%	0.50	74.22%	25.78%	0.35	73.28%	26.72%	0.36
less application availability	38.65%	12.87%	7.46%	10.68%	11.41%	13.43%	5.50%	1.18	53.12%	46.88%	0.88	50.73%	49.27%	0.97
less multitasking	21.32%	19.01%	15.40%	16.26%	11.94%	8.82%	7.25%	0.74	58.80%	41.20%	0.70	58.73%	41.27%	0.70
less voice command functionality	30.97%	16.28%	18.60%	10.85%	9.21%	7.07%	7.02%	0.77	60.19%	39.81%	0.66	56.08%	43.92%	0.78
Modeling monotonic preferences in…														
price[8]	29.95%	19.26%	13.24%	11.16%	11.05%	7.83%	7.51%	0.71	66.48%	33.52%	0.50	60.98%	39.02%	0.64
all attributes except brand and screen size	29.28%	19.62%	12.96%	11.47%	10.83%	8.15%	29.28%	0.75	64.93%	35.07%	0.54	58.74%	41.26%	0.70
Summary Statistics														
Minimum	19.81%	12.87%	7.46%	10.20%	9.21%	7.02%	5.50%	0.47	53.12%	25.56%	0.34	50.73%	24.97%	0.33
Maximum	38.65%	24.89%	18.60%	16.26%	15.73%	13.43%	29.28%	1.18	74.44%	46.88%	0.88	75.03%	49.27%	0.97
Median	29.13%	19.58%	13.48%	11.34%	11.15%	7.85%	7.50%	0.71	66.12%	33.88%	0.51	60.03%	39.97%	0.67
Mean	27.96%	19.78%	13.42%	11.70%	11.51%	8.11%	8.50%	0.71	65.94%	34.06%	0.53	60.87%	39.13%	0.65
Standard Deviation	4.12%	2.51%	2.07%	1.30%	1.43%	1.27%	4.68%	0.13	4.90%	4.90%	0.12	5.07%	5.07%	0.13

Exhibit E9. Sensitivity Analysis of Preference Share Simulations
Android Preference Shares With and Without Select Feature Infringement

	Shugan Exhibit*	Kearl Exhibit	Base Case Preference Shares: Apple	Blackberry	Windows	Android	Reduction in Android Preference Share: Scenario 1: Infringing but for application startup time	Scenario 2: Infringing but for availability of applications	Scenario 3: Not infringing both select features	Ratio of Scenario 1 to Scenario 2
Prof. Shugan's Base Case	E3a		28.4%	15.0%	12.4%	44.3%	19.9%	7.9%	25.7%	2.50
Excluding Potentially Unreliable Responses										
Page time on instructions < 10 seconds		E9a	28.2%	16.0%	13.2%	42.5%	28.2%	10.9%	34.8%	2.60
Page time on choice task < 5 seconds		E9b	28.2%	13.9%	12.8%	45.1%	22.0%	7.4%	27.9%	2.97
Page time on choice task < 10 seconds		E9c	25.6%	11.4%	12.5%	50.6%	27.0%	6.6%	33.6%	4.08
< 3 minutes to complete survey	E3b		27.9%	15.2%	13.0%	43.9%	20.9%	7.5%	26.4%	2.79
Entered survey more than once	E3f		28.6%	15.0%	12.3%	44.1%	19.4%	7.8%	25.4%	2.49
< 5 minutes to complete survey or entered survey more than once		E9d	26.3%	14.6%	13.6%	45.5%	25.0%	8.3%	31.1%	3.00
Alternative Estimation Techniques										
Including Choice Tasks with "None" Option Selected		E9e	27.5%	15.4%	12.4%	44.7%	21.0%	6.8%	26.1%	3.10
Simple Logit		E9f	29.3%	14.9%	16.5%	39.4%	18.4%	6.9%	24.6%	2.67
Excluding Respondents with Potentially Different Underlying Preferences										
Possibly employer-constrained										
Phone provided by employer	E3c		27.7%	15.2%	11.8%	45.3%	19.7%	7.0%	25.2%	2.81
Phone options constrained by employer	E3d		27.9%	14.8%	12.0%	45.3%	19.4%	7.1%	24.9%	2.73
Any of the above, or phone used for work		E9g	28.6%	14.5%	10.3%	46.6%	21.4%	5.4%	24.9%	3.95
Choose same operating system brand in all choice tasks		E9h	21.3%	16.7%	14.5%	47.5%	22.9%	9.0%	29.3%	2.55
Intend to purchase smartphone within next six months	E3e		26.3%	15.1%	13.0%	45.6%	19.6%	6.6%	24.8%	2.97
Eliminating Inconsistent Economic Preferences										
Excluding respondents who prefer…										
a higher price	RE1b		27.6%	19.9%	11.6%	40.8%	22.7%	9.6%	29.9%	2.36
a slower application startup time	RE1c		35.1%	9.5%	17.4%	38.1%	31.7%	9.1%	38.0%	3.48
a higher price or a slower app startup time	RE1d		33.9%	12.5%	15.9%	37.8%	33.9%	10.3%	41.3%	3.29
less application availability		E9i	51.4%	6.8%	8.0%	33.8%	14.1%	15.4%	24.4%	0.91
less multitasking		E9j	24.3%	16.5%	8.3%	50.9%	22.1%	14.2%	32.3%	1.56
less voice command functionality		E9k	27.4%	10.3%	11.0%	51.3%	16.9%	6.6%	22.7%	2.55
Modeling monotonic preferences in…										
price	RE1e		28.4%	15.5%	12.4%	43.7%	20.0%	7.6%	25.7%	2.63
all attributes except brand and screen size		E9l	29.3%	15.8%	11.6%	43.3%	20.7%	9.5%	28.0%	2.17
Changing Product Attribute Assumptions for Market Simulation										
Change assumptions on screen size and application availability		E9m	31.9%	14.9%	13.1%	40.1%	18.4%	8.3%	24.4%	2.22
Assume all phones have voice texting		E9n	32.5%	18.5%	17.6%	31.4%	23.6%	12.8%	32.4%	1.84
Include additional smartphones		E9o	36.1%	8.4%	10.1%	45.4%	19.3%	6.9%	25.0%	2.78
All of the above		E9p	42.9%	9.5%	11.6%	36.0%	24.3%	10.1%	31.3%	2.40
Summary Statitsics										
Minimum			21.3%	6.8%	8.0%	31.4%	14.1%	5.4%	22.7%	0.91
Maximum			51.4%	19.9%	17.6%	51.3%	33.9%	15.4%	41.3%	4.08
Median			28.3%	15.0%	12.4%	44.2%	20.9%	7.9%	26.2%	2.65
Mean			30.1%	14.1%	12.7%	43.2%	22.0%	8.7%	28.5%	2.67
Standard Deviation			6.1%	3.1%	2.3%	4.9%	4.4%	2.4%	4.7%	0.66

Notes:
* Exhibit numbers starting with "E" and "RE" correspond to exhibits referenced in Prof. Shugan's original and reply report, respectively.

Exhibit E9a. Android Preference Shares With and Without Select Feature Infringement

Excluding Respondents Who Spent Less Than 10 seconds on Instructions

Respondents (N = 450)

	Apple	**BlackBerry**	**Windows**	**Android**			
	All Scenarios			Base case: Android infringement	Scenario 1: Infringing but for application startup time	Scenario 2: Infringing but for availability of applications	Scenario 3: Not infringing both select features
Features							
Screen size *(inch)*	3.5	3.5	4.5	4.0	4.0	4.0	4.0
Price	$200	$100	$200	$200	$200	$200	$200
Voice commands[2]	Voice dialing	Voice dialing	Voice dialing	Voice dialing & texting	Voice dialing & texting	Voice dialing & texting	Voice dialing & texting
App startup time *(seconds)*	0.2	2	0.2	2	4	2	4
Availability of applications[3] *(number of applications)*	300,000	40,000	40,000	100,000	100,000	40,000	40,000
Multitasking *(number of applications)*[4]	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5
Preference shares							
Base case:	28.2%	16.0%	13.2%	42.5%			
Scenario 1:	32.0%	19.3%	18.2%		30.5%		
Scenario 2:	30.5%	17.6%	14.0%			37.9%	
Scenario 3:	33.3%	20.3%	18.7%				27.7%
Loss of preference share for Android between base case and infringing/non-infringing scenarios:					**28.2%**	**10.9%**	**34.8%**

Source: instrct gt10s Simulation1.xls

Exhibit E9b. Android Preference Shares With and Without Select Feature Infringement

Excluding Respondent-Choice Task Pairs Where Page Time Is Less Than 5 Seconds

Respondents (N = 783)

	Apple	BlackBerry	Windows	Android			
	All Scenarios			Base case: Android infringement	Scenario 1: Infringing but for application startup time	Scenario 2: Infringing but for availability of applications	Scenario 3: Not infringing both select features
Features							
Screen size *(inch)*	3.5	3.5	4.5	4.0	4.0	4.0	4.0
Price	$200	$100	$200	$200	$200	$200	$200
Voice commands[2]	Voice dialing	Voice dialing	Voice dialing	Voice dialing & texting	Voice dialing & texting	Voice dialing & texting	Voice dialing & texting
App startup time *(seconds)*	0.2	2	0.2	2	4	2	4
Availability of applications[3] *(number of applications)*	300,000	40,000	40,000	100,000	100,000	40,000	40,000
Multitasking *(number of applications)*[4]	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5
Preference shares							
Base case:	28.2%	13.9%	12.8%	45.1%			
Scenario 1:	31.4%	16.3%	17.1%		35.2%		
Scenario 2:	30.1%	14.8%	13.3%			41.8%	
Scenario 3:	32.8%	17.0%	17.7%				32.5%
Loss of preference share for Android between base case and infringing/non-infringing scenarios:					**22.0%**	**7.4%**	**27.9%**

Source: qt5s q Simulation1.xls

Exhibit E9c. Android Preference Shares With and Without Select Feature Infringement

Excluding Respondent-Choice Task Pairs Where Page Time Is Less Than 10 Seconds

Respondents (N = 771)

	Apple	**BlackBerry**	**Windows**	**Android**			
	All Scenarios			Base case: Android infringement	Scenario 1: Infringing but for application startup time	Scenario 2: Infringing but for availability of applications	Scenario 3: Not infringing both select features
Features							
Screen size *(inch)*	3.5	3.5	4.5	4.0	4.0	4.0	4.0
Price	$200	$100	$200	$200	$200	$200	$200
Voice commands[2]	Voice dialing	Voice dialing	Voice dialing	Voice dialing & texting	Voice dialing & texting	Voice dialing & texting	Voice dialing & texting
App startup time *(seconds)*	0.2	2	0.2	2	4	2	4
Availability of applications[3] *(number of applications)*	300,000	40,000	40,000	100,000	100,000	40,000	40,000
Multitasking *(number of applications)*[4]	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5
Preference shares							
Base case:	25.6%	11.4%	12.5%	50.6%			
Scenario 1:	30.1%	15.0%	18.0%		36.9%		
Scenario 2:	27.5%	12.2%	13.1%			47.2%	
Scenario 3:	31.7%	15.9%	18.8%				33.6%
Loss of preference share for Android between base case and infringing/non-infringing scenarios:					**27.0%**	**6.6%**	**33.6%**

Source: qt10s q Simulation1.xls

Exhibit E9d. Android Preference Shares With and Without Select Feature Infringement

Excluding Respondents with Elapsed Time Less than 5 minutes and Respondents who Entered the Survey More than Once

Respondents (N = 591)

	Apple	**BlackBerry**	**Windows**	**Android**			
	All Scenarios			Base case: Android infringement	Scenario 1: Infringing but for application startup time	Scenario 2: Infringing but for availability of applications	Scenario 3: Not infringing both select features
Features							
Screen size *(inch)*	3.5	3.5	4.5	4.0	4.0	4.0	4.0
Price	$200	$100	$200	$200	$200	$200	$200
Voice commands[2]	Voice dialing	Voice dialing	Voice dialing	Voice dialing & texting	Voice dialing & texting	Voice dialing & texting	Voice dialing & texting
App startup time *(seconds)*	0.2	2	0.2	2	4	2	4
Availability of applications[3] *(number of applications)*	300,000	40,000	40,000	100,000	100,000	40,000	40,000
Multitasking *(number of applications)* [4]	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5
Preference shares							
Base case:	26.3%	14.6%	13.6%	45.5%			
Scenario 1:	30.1%	17.1%	18.7%		34.1%		
Scenario 2:	28.5%	15.7%	14.1%			41.7%	
Scenario 3:	31.4%	18.0%	19.2%				31.3%
Loss of preference share for Android between base case and infringing/non-infringing scenarios:					**25.0%**	**8.3%**	**31.1%**

Source: excl elapse5m Simulation1.xls

Exhibit E9e. Android Preference Shares With and Without Select Feature Infringement

Including the None Option in Estimation

Respondents (N = 784)

	Apple	BlackBerry	Windows	Android			
	All Scenarios			Base case: Android infringement	Scenario 1: Infringing but for application startup time	Scenario 2: Infringing but for availability of applications	Scenario 3: Not infringing both select features
Features							
Screen size *(inch)*	3.5	3.5	4.5	4.0	4.0	4.0	4.0
Price	$200	$100	$200	$200	$200	$200	$200
Voice commands[2]	Voice dialing	Voice dialing	Voice dialing	Voice dialing & texting	Voice dialing & texting	Voice dialing & texting	Voice dialing & texting
App startup time *(seconds)*	0.2	2	0.2	2	4	2	4
Availability of applications[3] *(number of applications)*	300,000	40,000	40,000	100,000	100,000	40,000	40,000
Multitasking *(number of applications)*[4]	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5
Preference shares							
Base case:	27.5%	15.4%	12.4%	44.7%			
Scenario 1:	30.7%	17.4%	16.6%		35.3%		
Scenario 2:	29.3%	16.3%	12.8%			41.6%	
Scenario 3:	31.9%	18.1%	17.0%				33.0%
Loss of preference share for Android between base case and infringing/non-infringing scenarios:					**21.0%**	**6.8%**	**26.1%**

Source: Sim A none Simulation1.xls

Exhibit E9f. Android Preference Shares With and Without Select Feature Infringement

Hierarchical Bayesian Model vs. Simple Logit Model

All Respondents (N = 784)

	Apple	BlackBerry	Windows	Android			
	All Scenarios			Base case: Android infringement	Scenario 1: Infringing but for application startup time	Scenario 2: Infringing but for availability of applications	Scenario 3: Not infringing both select features
Features[1]							
Screen size *(inch)*	3.5	3.5	4.5	4.0	4.0	4.0	4.0
Price	$200	$100	$200	$200	$200	$200	$200
Voice commands	Voice dialing	Voice dialing	Voice dialing	Voice dialing & texting	Voice dialing & texting	Voice dialing & texting	Voice dialing & texting
App startup time *(seconds)*	0.2	2	0.2	2	4	2	4
Availability of applications *(number of applications)*	300,000	40,000	40,000	100,000	100,000	40,000	40,000
Multitasking *(number of applications)*	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5
Hierarchical Bayesian Model Preference Shares[1]							
Base case:	28.4%	15.0%	12.4%	44.3%			
Scenario 1:	31.2%	17.2%	16.1%		35.5%		
Scenario 2:	30.2%	16.1%	12.9%			40.8%	
Scenario 3:	32.5%	18.1%	16.5%				32.9%
Loss of preference share for Android between base case and infringing/non-infringing scenarios:					**19.9%**	**7.9%**	**25.7%**
Simple Logit Model Preference Shares							
Base case:	29.3%	14.9%	16.5%	39.4%			
Scenario 1:	32.7%	16.7%	18.4%		32.1%		
Scenario 2:	30.6%	15.6%	17.2%			36.7%	
Scenario 3:	33.9%	17.3%	19.1%				29.7%
Loss of preference share for Android between base case and infringing/non-infringing scenarios:					**18.4%**	**6.9%**	**24.6%**

Sources: Shugan Report, Exhibit 3a.; Exhibit 10a.

Exhibit E9g. Android Preference Shares With and Without Select Feature Infringement

Excluding Respondents Indicating Work Use

Respondents (N = 337)

				Android			
	Apple	**BlackBerry**	**Windows**	Base case: Android infringement	Scenario 1: Infringing but for application startup time	Scenario 2: Infringing but for availability of applications	Scenario 3: Not infringing both select features
		All Scenarios					
Features							
Screen size *(inch)*	3.5	3.5	4.5	4.0	4.0	4.0	4.0
Price	$200	$100	$200	$200	$200	$200	$200
Voice commands[2]	Voice dialing	Voice dialing	Voice dialing	Voice dialing & texting	Voice dialing & texting	Voice dialing & texting	Voice dialing & texting
App startup time *(seconds)*	0.2	2	0.2	2	4	2	4
Availability of applications[3] *(number of applications)*	300,000	40,000	40,000	100,000	100,000	40,000	40,000
Multitasking *(number of applications)*[4]	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5
Preference shares							
Base case:	28.6%	14.5%	10.3%	46.6%			
Scenario 1:	31.3%	17.9%	14.2%		36.6%		
Scenario 2:	30.2%	15.6%	10.2%			44.1%	
Scenario 3:	32.2%	18.7%	14.1%				35.0%
Loss of preference share for Android between base case and infringing/non-infringing scenarios:					**21.4%**	**5.4%**	**24.9%**

Source: excl work Simulation1.xls

Exhibit E9h. Android Preference Shares With and Without Select Feature Infringement

Excluding Respondents Choosing the Same Operating System Brand in All Choice Tasks

Respondents (N = 683)

	Apple	BlackBerry	Windows	Android			
	All Scenarios			Base case: Android infringement	Scenario 1: Infringing but for application startup time	Scenario 2: Infringing but for availability of applications	Scenario 3: Not infringing both select features
Features							
Screen size *(inch)*	3.5	3.5	4.5	4.0	4.0	4.0	4.0
Price	$200	$100	$200	$200	$200	$200	$200
Voice commands[2]	Voice dialing	Voice dialing	Voice dialing	Voice dialing & texting	Voice dialing & texting	Voice dialing & texting	Voice dialing & texting
App startup time *(seconds)*	0.2	2	0.2	2	4	2	4
Availability of applications[3] *(number of applications)*	300,000	40,000	40,000	100,000	100,000	40,000	40,000
Multitasking *(number of applications)*[4]	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5
Preference shares							
Base case:	21.3%	16.7%	14.5%	47.5%			
Scenario 1:	24.9%	19.4%	19.1%		36.6%		
Scenario 2:	23.7%	18.0%	15.1%			43.2%	
Scenario 3:	26.6%	20.3%	19.6%				33.6%
Loss of preference share for Android between base case and infringing/non-infringing scenarios:					**22.9%**	**9.0%**	**29.3%**

Source: excl loyl Simulation1.xls

Exhibit E9i. Android Preference Shares With and Without Select Feature Infringement

Excluding Respondents Preferring a Smaller Number of Applications

Respondents (N = 309)

	Apple	BlackBerry	Windows	Android			
	All Scenarios			Base case: Android infringement	Scenario 1: Infringing but for application startup time	Scenario 2: Infringing but for availability of applications	Scenario 3: Not infringing both select features
Features							
Screen size *(inch)*	3.5	3.5	4.5	4.0	4.0	4.0	4.0
Price	$200	$100	$200	$200	$200	$200	$200
Voice commands[2]	Voice dialing	Voice dialing	Voice dialing	Voice dialing & texting	Voice dialing & texting	Voice dialing & texting	Voice dialing & texting
App startup time *(seconds)*	0.2	2	0.2	2	4	2	4
Availability of applications[3] *(number of applications)*	300,000	40,000	40,000	100,000	100,000	40,000	40,000
Multitasking *(number of applications)* [4]	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5
Preference shares							
Base case:	51.4%	6.8%	8.0%	33.8%			
Scenario 1:	54.1%	7.9%	9.0%		29.0%		
Scenario 2:	54.7%	7.5%	9.2%			28.6%	
Scenario 3:	56.3%	8.2%	10.0%				25.5%
Loss of preference share for Android between base case and infringing/non-infringing scenarios:					**14.1%**	**15.4%**	**24.4%**

Source: A PRNApp Simulation1.xls

Exhibit E9j. Android Preference Shares With and Without Select Feature Infringement
Excluding Respondents Preferring Less Multitasking
Respondents (N = 326)

	Apple	**BlackBerry**	**Windows**	**Android**			
	All Scenarios			Base case: Android infringement	Scenario 1: Infringing but for application startup time	Scenario 2: Infringing but for availability of applications	Scenario 3: Not infringing both select features
Features							
Screen size *(inch)*	3.5	3.5	4.5	4.0	4.0	4.0	4.0
Price	$200	$100	$200	$200	$200	$200	$200
Voice commands[2]	Voice dialing	Voice dialing	Voice dialing	Voice dialing & texting	Voice dialing & texting	Voice dialing & texting	Voice dialing & texting
App startup time *(seconds)*	0.2	2	0.2	2	4	2	4
Availability of applications[3] *(number of applications)*	300,000	40,000	40,000	100,000	100,000	40,000	40,000
Multitasking *(number of applications)*[4]	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5
Preference shares							
Base case:	24.3%	16.5%	8.3%	50.9%			
Scenario 1:	28.2%	19.5%	12.7%		39.6%		
Scenario 2:	27.4%	19.0%	9.9%			43.6%	
Scenario 3:	30.0%	21.4%	14.2%				34.4%
Loss of preference share for Android between base case and infringing/non-infringing scenarios:					**22.1%**	**14.2%**	**32.3%**

Source: A PRMtsk Simulation1.xls

Exhibit E9k. Android Preference Shares With and Without Select Feature Infringement

Excluding Respondents Preferring Less Voice Command Functionality

Respondents (N = 497)

	Apple	**BlackBerry**	**Windows**	**Android**			
	All Scenarios			Base case: Android infringement	Scenario 1: Infringing but for application startup time	Scenario 2: Infringing but for availability of applications	Scenario 3: Not infringing both select features
Features							
Screen size *(inch)*	3.5	3.5	4.5	4.0	4.0	4.0	4.0
Price	$200	$100	$200	$200	$200	$200	$200
Voice commands[2]	Voice dialing	Voice dialing	Voice dialing	Voice dialing & texting	Voice dialing & texting	Voice dialing & texting	Voice dialing & texting
App startup time *(seconds)*	0.2	2	0.2	2	4	2	4
Availability of applications[3] *(number of applications)*	300,000	40,000	40,000	100,000	100,000	40,000	40,000
Multitasking *(number of applications)*[4]	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5
Preference shares							
Base case:	27.4%	10.3%	11.0%	51.3%			
Scenario 1:	30.0%	12.3%	15.1%		42.6%		
Scenario 2:	29.3%	11.2%	11.6%			47.9%	
Scenario 3:	31.5%	13.0%	15.8%				39.6%
Loss of preference share for Android between base case and infringing/non-infringing scenarios:					**16.9%**	**6.6%**	**22.7%**

Source: A PRVC Simulation1.xls

Exhibit E9I. Android Preference Shares With and Without Select Feature Infringement

Constraining Mean Partworths to be Monotonically Inreasing With Improvement in Attribute Level (Except Brand and Screen Size)

Respondents (N = 784)

	Apple	**BlackBerry**	**Windows**	**Android**			
	All Scenarios			Base case: Android infringement	Scenario 1: Infringing but for application startup time	Scenario 2: Infringing but for availability of applications	Scenario 3: Not infringing both select features
Features							
Screen size *(inch)*	3.5	3.5	4.5	4.0	4.0	4.0	4.0
Price	$200	$100	$200	$200	$200	$200	$200
Voice commands[2]	Voice dialing	Voice dialing	Voice dialing	Voice dialing & texting	Voice dialing & texting	Voice dialing & texting	Voice dialing & texting
App startup time *(seconds)*	0.2	2	0.2	2	4	2	4
Availability of applications[3] *(number of applications)*	300,000	40,000	40,000	100,000	100,000	40,000	40,000
Multitasking *(number of applications)* [4]	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5
Preference shares							
Base case:	29.3%	15.8%	11.6%	43.3%			
Scenario 1:	32.2%	18.0%	15.5%		34.3%		
Scenario 2:	31.3%	16.8%	12.7%			39.1%	
Scenario 3:	33.7%	18.8%	16.4%				31.2%
Loss of preference share for Android between base case and infringing/non-infringing scenarios:					**20.7%**	**9.5%**	**28.0%**

Source: Cnstrn Simulation1.xls

Exhibit E9m. Android Preference Shares With and Without Select Feature Infringement
Changing Assumptions on Screen Size and Application Availability
All Respondents (N = 784)

	Apple	BlackBerry	Windows	Android			
	All Scenarios			Base case: Android infringement	Scenario 1: Infringing but for application startup time	Scenario 2: Infringing but for availability of applications	Scenario 3: Not infringing both select features
Features							
Screen size *(inch)*	3.5	3.5	4.5	3.5	3.5	3.5	3.5
Price	$200	$100	$200	$200	$200	$200	$200
Voice commands[2]	Voice dialing	Voice dialing	Voice dialing	Voice dialing & texting	Voice dialing & texting	Voice dialing & texting	Voice dialing & texting
App startup time *(seconds)*	0.2	2	0.2	2	4	2	4
Availability of applications[3] *(number of applications)*	300,000	6000	6000	100,000	100,000	40,000	40,000
Multitasking *(number of applications)*[4]	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5
Preference shares							
Base case:	31.9%	14.9%	13.1%	40.1%			
Scenario 1:	35.1%	16.6%	15.6%		32.7%		
Scenario 2:	33.7%	15.9%	13.7%			36.7%	
Scenario 3:	36.1%	17.5%	16.1%				30.3%
Loss of preference share for Android between base case and infringing/non-infringing scenarios:					**18.4%**	**8.3%**	**24.4%**

Source: Sim A Simulation ChngShgn.xls

Exhibit E9n. Android Preference Shares With and Without Select Feature Infringement

Assuming All Phones Have Voice Texting

All Respondents (N = 784)

	Apple	BlackBerry	Windows	Android: Base case: Android infringement	Android: Scenario 1: Infringing but for application startup time	Android: Scenario 2: Infringing but for availability of applications	Android: Scenario 3: Not infringing both select features
	All Scenarios						
Features							
Screen size *(inch)*	3.5	3.5	4.5	4.0	4.0	4.0	4.0
Price	$200	$100	$200	$200	$200	$200	$200
Voice commands[2]	Voice dialing & texting	Voice dialing & texting	Voice dialing & texting	Voice dialing & texting	Voice dialing & texting	Voice dialing & texting	Voice dialing & texting
App startup time *(seconds)*	0.2	2	0.2	2	4	2	4
Availability of applications[3] *(number of applications)*	300,000	40,000	40,000	100,000	100,000	40,000	40,000
Multitasking *(number of applications)*[4]	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5
Preference shares							
Base case:	32.5%	18.5%	17.6%	31.4%			
Scenario 1:	34.8%	20.5%	20.8%		23.9%		
Scenario 2:	34.5%	19.6%	18.6%			27.3%	
Scenario 3:	36.0%	21.2%	21.6%				21.2%
Loss of preference share for Android between base case and infringing/non-infringing scenarios:					**23.6%**	**12.8%**	**32.4%**

Source: Sim A Simulation Vtxt AllPhn.xls

Exhibit E9o. Android Preference Shares With and Without Select Feature Infringement

Including Additional Smartphones

All Respondents (N = 784)

	Apple	BlackBerry	Windows	Android			
	All Scenarios			Base case: Android infringement	Scenario 1: Infringing but for application startup time	Scenario 2: Infringing but for availability of applications	Scenario 3: Not infringing both select features
Features							
Screen size *(inch)*	3.5	3.5	4.0/4.5	3.5-4.5	3.5-4.5	3.5-4.5	3.5-4.5
Price	\$100/\$200	\$100	\$200	\$200	\$200	\$200	\$200
Voice commands[2]	Voice dialing	Voice dialing	Voice dialing	Voice dialing & texting	Voice dialing & texting	Voice dialing & texting	Voice dialing & texting
App startup time *(seconds)*	2/0.2	2	0.2	2	4	2	4
Availability of applications[3] *(number of applications)*	300,000	40,000	40,000	100,000	100,000	40,000	40,000
Multitasking *(number of applications)*[4]	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5
Preference shares							
Base case:	36.1%	8.4%	10.1%	45.4%			
Scenario 1:	39.8%	9.6%	13.9%		36.7%		
Scenario 2:	38.5%	8.8%	10.4%			42.3%	
Scenario 3:	41.4%	10.1%	14.4%				34.1%
Loss of preference share for Android between base case and infringing/non-infringing scenarios:					**19.3%**	**6.9%**	**25.0%**

Note:
Additional smartphones include: (1) an Apple phone with application startup time of 2 seconds and price of \$100; (2) a Windows 7 phone with screen size of 4 inches; (3) an Android phone with screen size of 3.5 inches; and (4) an Android phone with screen size of 4.5 inches.

Source: Sim_A Simulation AddPhn.xls

Exhibit E9p. Android Preference Shares With and Without Select Feature Infringement

Changing Shugan's Assumptions on Screen Size and Application Availability, Assuming All Phones Have Voice-Texting, and Including Additional Smartphones

All Respondents (N = 784)

	Apple	**BlackBerry**	**Windows**	**Android**			
	All Scenarios			Base case: Android infringement	Scenario 1: Infringing but for application startup time	Scenario 2: Infringing but for availability of applications	Scenario 3: Not infringing both select features
Features							
Screen size *(inch)*	3.5	3.5	4.0/4.5	3.5-4.5	3.5-4.5	3.5-4.5	3.5-4.5
Price	$100/$200	$100	$200	$200	$200	$200	$200
Voice commands[2]	Voice dialing & texting	Voice dialing & texting	Voice dialing & texting	Voice dialing & texting	Voice dialing & texting	Voice dialing & texting	Voice dialing & texting
App startup time *(seconds)*	2/0.2	2	0.2	2	4	2	4
Availability of applications[3] *(number of applications)*	300,000	6,000	6,000	100,000	100,000	40,000	40,000
Multitasking *(number of applications)*[4]	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5	Up to 5
Preference shares							
Base case:	42.9%	9.5%	11.6%	36.0%			
Scenario 1:	47.1%	10.6%	15.1%		27.3%		
Scenario 2:	45.0%	10.1%	12.5%			32.4%	
Scenario 3:	48.4%	11.0%	15.8%				24.8%
Loss of preference share for Android between base case and infringing/non-infringing scenarios:					**24.3%**	**10.1%**	**31.3%**

Note:
Additional smartphones include: (1) an Apple phone with application startup time of 2 seconds and price of $100; (2) a Windows 7 phone with screen size of 4 inches; (3) an Android phone with screen size of 3.5 inches; and (4) an Android phone with screen size of 4.5 inches.

Source: Sim_A Simulation CumSim.xls

Exhibit E10a. Simple Logit Model Estimation Results
Pooled and Question-by-Question Estimations

Dummy Variables	All Questions Pooled	Single Choice Question Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16
Operating System																	
Android	0.632	0.601	0.621	0.722	0.631	0.699	0.710	0.718	0.796	0.573	0.512	0.487	0.596	0.590	0.676	0.668	0.648
	[0.030]*	[0.114]*	[0.122]*	[0.122]*	[0.123]*	[0.122]*	[0.122]*	[0.126]*	[0.127]*	[0.116]*	[0.118]*	[0.115]*	[0.123]*	[0.123]*	[0.124]*	[0.124]*	[0.124]*
Apple	0.754	0.692	0.795	0.747	0.786	0.815	0.804	0.884	0.887	0.678	0.613	0.593	0.768	0.771	0.869	0.803	0.774
	[0.030]*	[0.114]*	[0.117]*	[0.122]*	[0.120]*	[0.121]*	[0.121]*	[0.124]*	[0.126]*	[0.116]*	[0.114]*	[0.111]*	[0.119]*	[0.123]*	[0.121]*	[0.122]*	[0.122]*
Blackberry	-0.024	-0.236	-0.001	0.017	0.038	0.001	0.074	0.064	0.231	-0.231	-0.130	-0.282	-0.142	-0.066	0.061	0.201	0.110
	[0.034]	[0.136]+	[0.134]	[0.141]	[0.133]	[0.137]	[0.138]	[0.141]	[0.139]+	[0.140]+	[0.132]	[0.134]*	[0.139]	[0.142]	[0.138]	[0.132]	[0.137]
Screen Size																	
3.5 inch	-0.327	-0.380	-0.354	-0.403	-0.330	-0.198	-0.386	-0.418	-0.382	-0.333	-0.287	-0.228	-0.334	-0.377	-0.391	-0.197	-0.264
	[0.026]*	[0.106]*	[0.104]*	[0.106]*	[0.105]*	[0.107]+	[0.105]*	[0.110]*	[0.106]*	[0.107]*	[0.104]*	[0.104]*	[0.105]*	[0.108]*	[0.107]*	[0.105]+	[0.109]*
4.0 inch	-0.112	-0.040	-0.036	-0.132	-0.183	0.030	-0.258	-0.187	-0.156	0.055	-0.108	-0.124	-0.226	-0.145	-0.215	-0.045	-0.041
	[0.025]*	[0.096]	[0.101]	[0.101]	[0.103]+	[0.103]	[0.102]*	[0.102]+	[0.102]	[0.100]	[0.100]	[0.103]	[0.105]*	[0.106]	[0.102]*	[0.102]	[0.101]
Price																	
300	-0.968	-0.620	-1.005	-0.986	-1.063	-0.979	-0.839	-1.048	-1.056	-0.877	-0.863	-1.046	-0.912	-1.150	-1.100	-0.970	-1.052
	[0.027]*	[0.105]*	[0.113]*	[0.110]*	[0.115]*	[0.110]*	[0.111]*	[0.112]*	[0.110]*	[0.109]*	[0.111]*	[0.113]*	[0.110]*	[0.116]*	[0.111]*	[0.112]*	[0.112]*
200	-0.432	-0.173	-0.392	-0.523	-0.407	-0.488	-0.314	-0.603	-0.618	-0.323	-0.292	-0.382	-0.539	-0.603	-0.462	-0.286	-0.540
	[0.024]*	[0.095]+	[0.095]*	[0.099]*	[0.095]*	[0.099]*	[0.096]*	[0.099]*	[0.098]*	[0.096]*	[0.097]*	[0.094]*	[0.099]*	[0.099]*	[0.095]*	[0.095]*	[0.097]*
Voice Commands																	
None	-0.568	-0.402	-0.550	-0.597	-0.606	-0.602	-0.425	-0.707	-0.666	-0.504	-0.714	-0.563	-0.554	-0.673	-0.501	-0.560	-0.551
	[0.026]*	[0.099]*	[0.102]*	[0.106]*	[0.104]*	[0.104]*	[0.103]*	[0.106]*	[0.106]*	[0.105]*	[0.107]*	[0.104]*	[0.107]*	[0.110]*	[0.104]*	[0.103]*	[0.108]*
Dialing only	-0.418	-0.33	-0.547	-0.452	-0.469	-0.399	-0.423	-0.591	-0.407	-0.281	-0.409	-0.469	-0.386	-0.37	-0.44	-0.422	-0.32
	[0.025]*	[0.099]*	[0.101]*	[0.102]*	[0.101]*	[0.101]*	[0.101]*	[0.105]*	[0.100]*	[0.101]*	[0.098]*	[0.101]*	[0.101]*	[0.102]*	[0.102]*	[0.101]*	[0.101]*
Multitasking																	
1 app at a time	-0.500	-0.323	-0.327	-0.661	-0.569	-0.542	-0.672	-0.508	-0.471	-0.565	-0.538	-0.409	-0.637	-0.462	-0.416	-0.400	-0.546
	[0.027]*	[0.103]*	[0.109]*	[0.111]*	[0.107]*	[0.112]*	[0.109]*	[0.109]*	[0.114]*	[0.109]*	[0.109]*	[0.107]*	[0.112]*	[0.115]*	[0.108]*	[0.108]*	[0.108]*
Up to 5 apps	-0.019	-0.050	0.178	-0.132	-0.112	0.067	-0.218	-0.112	0.180	-0.028	0.065	-0.098	-0.017	0.118	-0.022	-0.025	-0.117
	[0.024]	[0.098]	[0.100]+	[0.098]	[0.099]	[0.099]	[0.096]*	[0.099]	[0.099]+	[0.099]	[0.098]	[0.099]	[0.100]	[0.101]	[0.100]	[0.100]	[0.099]
Availability of Applications																	
6,000 apps	-0.287	-0.244	-0.279	-0.203	-0.330	-0.230	-0.234	-0.315	-0.460	-0.337	-0.459	-0.163	-0.381	-0.340	-0.229	-0.162	-0.363
	[0.029]*	[0.114]*	[0.117]*	[0.124]+	[0.116]*	[0.119]+	[0.118]*	[0.122]*	[0.119]*	[0.117]*	[0.121]*	[0.119]	[0.122]*	[0.127]*	[0.119]+	[0.116]	[0.119]*
40,000 apps	-0.147	-0.067	-0.148	0.002	-0.210	-0.131	-0.094	-0.154	-0.275	-0.128	-0.247	-0.096	-0.177	-0.078	-0.086	-0.344	-0.234
	[0.028]*	[0.112]	[0.114]	[0.117]	[0.115]+	[0.115]	[0.116]	[0.116]	[0.114]*	[0.112]	[0.115]*	[0.116]	[0.117]	[0.119]	[0.113]	[0.121]*	[0.114]*
100,000 apps	-0.032	-0.159	-0.020	0.032	-0.109	-0.076	-0.018	0.000	-0.134	-0.144	0.109	0.116	-0.028	0.106	-0.077	0.001	-0.167
	[0.028]	[0.112]	[0.111]	[0.116]	[0.111]	[0.112]	[0.111]	[0.113]	[0.113]	[0.112]	[0.108]	[0.113]	[0.111]	[0.115]	[0.115]	[0.112]	[0.114]
Application Startup Time																	
4 seconds	-0.498	-0.459	-0.535	-0.460	-0.435	-0.710	-0.461	-0.635	-0.548	-0.442	-0.663	-0.446	-0.679	-0.348	-0.570	-0.234	-0.416
	[0.026]*	[0.103]*	[0.106]*	[0.107]*	[0.108]*	[0.112]*	[0.107]*	[0.110]*	[0.109]*	[0.104]*	[0.108]*	[0.106]*	[0.109]*	[0.108]*	[0.108]*	[0.105]*	[0.108]*
2 seconds	-0.182	-0.314	-0.222	-0.135	0.030	-0.262	-0.100	-0.255	-0.178	-0.242	-0.256	-0.200	-0.232	-0.102	-0.261	-0.022	-0.138
	[0.025]*	[0.098]*	[0.100]*	[0.101]	[0.100]	[0.099]*	[0.100]	[0.101]*	[0.099]+	[0.100]*	[0.098]*	[0.100]*	[0.100]*	[0.105]	[0.100]*	[0.102]	[0.101]
Log likelihood	-13,176.86	-878.36	-838.09	-797.05	-818.18	-818.69	-822.84	-797.77	-805.64	-822.64	-828.40	-844.97	-791.15	-768.11	-812.57	-824.47	-803.81
# Observations	43,864	2,820	2,792	2,708	2,748	2,768	2,732	2,756	2,768	2,736	2,776	2,772	2,692	2,660	2,748	2,688	2,700

Notes:
[1] Variables listed are dummy variables that carry the value of 1 for the feature level specified, and 0 otherwise. The ommited feature level is Windows for operating system, and the most preferred level, as predicted by economic theory, for the remaining features (4.5 inch screen size, price of $100, voice commands for dialing and texting, multitasking of up to 9 apps at a time, 300000 apps, and 0.2 second delay in application startup time).
[2] Results reported under "All Questions Pooled" differ from the simple logit results reported in Exhibit [[7]] because effects-coded variables instead of dummy variables are used in Exhibit [[7]].
[3] Standard errors in brackets. + and * denote statistical significance at the 10% and 5% level, respectively.

Exhibit E10b. Simple Logit Model Estimation Results
Pooling All Questions Except One

Dummy Variables	All Questions Pooled	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16
		All Questions Pooled Except:															
Operating System																	
Android	0.632	0.637	0.633	0.626	0.633	0.627	0.627	0.626	0.621	0.636	0.641	0.642	0.634	0.635	0.629	0.630	0.632
	[0.030]*	[0.031]*	[0.031]*	[0.031]*	[0.031]*	[0.031]*	[0.031]*	[0.031]*	[0.031]*	[0.031]*	[0.031]*	[0.031]*	[0.031]*	[0.031]*	[0.031]*	[0.031]*	[0.031]*
Apple	0.754	0.760	0.751	0.754	0.752	0.750	0.752	0.746	0.745	0.761	0.765	0.766	0.753	0.754	0.746	0.751	0.753
	[0.030]*	[0.031]*	[0.031]*	[0.030]*	[0.030]*	[0.030]*	[0.030]*	[0.030]*	[0.030]*	[0.031]*	[0.031]*	[0.031]*	[0.030]*	[0.030]*	[0.030]*	[0.030]*	[0.030]*
Blackberry	-0.024	-0.009	-0.026	-0.026	-0.027	-0.026	-0.030	-0.029	-0.041	-0.010	-0.017	-0.007	-0.018	-0.020	-0.029	-0.039	-0.032
	[0.034]	[0.035]	[0.035]	[0.035]	[0.035]	[0.035]	[0.035]	[0.035]	[0.035]	[0.035]	[0.035]	[0.035]	[0.035]	[0.035]	[0.035]	[0.035]	[0.035]
Screen Size																	
3.5 inch	-0.327	-0.323	-0.325	-0.323	-0.327	-0.335	-0.322	-0.321	-0.323	-0.326	-0.330	-0.335	-0.327	-0.325	-0.323	-0.336	-0.331
	[0.026]*	[0.027]*	[0.027]*	[0.027]*	[0.027]*	[0.027]*	[0.027]*	[0.027]*	[0.027]*	[0.027]*	[0.027]*	[0.027]*	[0.027]*	[0.027]*	[0.027]*	[0.027]*	[0.027]*
4.0 inch	-0.112	-0.116	-0.116	-0.110	-0.107	-0.121	-0.102	-0.108	-0.109	-0.123	-0.112	-0.111	-0.107	-0.111	-0.106	-0.117	-0.116
	[0.025]*	[0.026]*	[0.026]*	[0.026]*	[0.026]*	[0.026]*	[0.026]*	[0.026]*	[0.026]*	[0.026]*	[0.026]*	[0.026]*	[0.026]*	[0.026]*	[0.026]*	[0.026]*	[0.026]*
Price																	
300	-0.968	-0.994	-0.967	-0.966	-0.962	-0.969	-0.976	-0.964	-0.963	-0.973	-0.975	-0.962	-0.972	-0.958	-0.960	-0.968	-0.964
	[0.027]*	[0.029]*	[0.028]*	[0.028]*	[0.028]*	[0.028]*	[0.028]*	[0.028]*	[0.028]*	[0.028]*	[0.028]*	[0.028]*	[0.028]*	[0.028]*	[0.028]*	[0.028]*	[0.028]*
200	-0.432	-0.450	-0.435	-0.426	-0.434	-0.429	-0.440	-0.423	-0.420	-0.439	-0.442	-0.435	-0.426	-0.422	-0.431	-0.443	-0.425
	[0.024]*	[0.025]*	[0.025]*	[0.025]*	[0.025]*	[0.025]*	[0.025]*	[0.025]*	[0.025]*	[0.025]*	[0.025]*	[0.025]*	[0.025]*	[0.025]*	[0.025]*	[0.025]*	[0.025]*
Voice Commands																	
None	-0.568	-0.580	-0.569	-0.566	-0.565	-0.565	-0.576	-0.560	-0.562	-0.572	-0.558	-0.569	-0.568	-0.562	-0.573	-0.569	-0.568
	[0.026]*	[0.027]*	[0.027]*	[0.027]*	[0.027]*	[0.027]*	[0.027]*	[0.027]*	[0.027]*	[0.027]*	[0.027]*	[0.027]*	[0.027]*	[0.027]*	[0.027]*	[0.027]*	[0.027]*
Dialing only	-0.418	-0.425	-0.408	-0.416	-0.415	-0.418	-0.418	-0.407	-0.418	-0.427	-0.418	-0.415	-0.42	-0.421	-0.417	-0.419	-0.425
	[0.025]*	[0.026]*	[0.026]*	[0.026]*	[0.026]*	[0.026]*	[0.026]*	[0.026]*	[0.026]*	[0.026]*	[0.026]*	[0.026]*	[0.026]*	[0.026]*	[0.026]*	[0.026]*	[0.026]*
Multitasking																	
1 app at a time	-0.500	-0.514	-0.511	-0.489	-0.495	-0.496	-0.489	-0.499	-0.501	-0.496	-0.497	-0.505	-0.493	-0.502	-0.505	-0.509	-0.497
	[0.027]*	[0.028]*	[0.028]*	[0.028]*	[0.028]*	[0.028]*	[0.028]*	[0.028]*	[0.028]*	[0.028]*	[0.028]*	[0.028]*	[0.028]*	[0.028]*	[0.028]*	[0.028]*	[0.028]*
Up to 5 apps	-0.019	-0.016	-0.032	-0.012	-0.014	-0.024	-0.006	-0.013	-0.033	-0.018	-0.026	-0.013	-0.021	-0.028	-0.020	-0.021	-0.013
	[0.024]	[0.025]	[0.025]	[0.025]	[0.025]	[0.025]	[0.025]	[0.025]	[0.025]	[0.025]	[0.025]	[0.025]	[0.025]	[0.025]	[0.025]	[0.025]	[0.025]
Availability of Applications																	
6,000 apps	-0.287	-0.291	-0.288	-0.293	-0.285	-0.291	-0.292	-0.286	-0.278	-0.284	-0.277	-0.296	-0.282	-0.285	-0.291	-0.299	-0.281
	[0.029]*	[0.031]*	[0.030]*	[0.030]*	[0.030]*	[0.030]*	[0.030]*	[0.030]*	[0.030]*	[0.030]*	[0.030]*	[0.030]*	[0.030]*	[0.030]*	[0.030]*	[0.030]*	[0.030]*
40,000 apps	-0.147	-0.153	-0.147	-0.156	-0.142	-0.148	-0.152	-0.146	-0.141	-0.148	-0.140	-0.150	-0.146	-0.153	-0.151	-0.135	-0.141
	[0.028]*	[0.029]*	[0.029]*	[0.029]*	[0.029]*	[0.029]*	[0.029]*	[0.029]*	[0.029]*	[0.029]*	[0.029]*	[0.029]*	[0.029]*	[0.029]*	[0.029]*	[0.029]*	[0.029]*
100,000 apps	-0.032	-0.024	-0.034	-0.037	-0.028	-0.030	-0.034	-0.035	-0.025	-0.025	-0.042	-0.043	-0.033	-0.042	-0.029	-0.035	-0.023
	[0.028]	[0.029]	[0.029]	[0.029]	[0.029]	[0.029]	[0.029]	[0.029]	[0.029]	[0.029]	[0.029]	[0.029]	[0.029]	[0.029]	[0.029]	[0.029]	[0.029]
Application Startup Time																	
4 seconds	-0.498	-0.500	-0.495	-0.500	-0.502	-0.485	-0.501	-0.490	-0.494	-0.502	-0.488	-0.501	-0.486	-0.508	-0.494	-0.517	-0.502
	[0.026]*	[0.027]*	[0.027]*	[0.027]*	[0.027]*	[0.027]*	[0.027]*	[0.027]*	[0.027]*	[0.027]*	[0.027]*	[0.027]*	[0.027]*	[0.027]*	[0.027]*	[0.027]*	[0.027]*
2 seconds	-0.182	-0.172	-0.179	-0.185	-0.196	-0.177	-0.188	-0.178	-0.182	-0.178	-0.175	-0.180	-0.179	-0.187	-0.177	-0.192	-0.184
	[0.025]*	[0.026]*	[0.026]*	[0.026]*	[0.026]*	[0.026]*	[0.026]*	[0.026]*	[0.026]*	[0.026]*	[0.026]*	[0.026]*	[0.026]*	[0.025]*	[0.026]*	[0.026]*	[0.026]*
Log likelihood	-13,176.86	-12,281.44	-12,334.01	-12,376.20	-12,354.24	-12,353.35	-12,347.22	-12,373.98	-12,362.88	-12,347.45	-12,338.27	-12,325.38	-12,380.60	-12,401.78	-12,360.70	-12,339.27	-12,369.15
# Observations	43,864	41,044	41,072	41,156	41,116	41,096	41,132	41,108	41,096	41,128	41,088	41,092	41,172	41,204	41,116	41,176	41,164

Notes:
[1] Variables listed are dummy variables that carry the value of 1 for the feature level specified, and 0 otherwise. The ommited feature level is Windows for operating system, and the most preferred level, as predicted by economic theory, for the remaining features (4.5 inch screen size, price of $100, voice commands for dialing and texting, multitasking of up to 9 apps at a time, 300000 apps, and 0.2 second delay in application startup time).
[2] Results reported under "All Questions Pooled" differ from the simple logit results reported in Exhibit [[7]] because effects-coded variables instead of dummy variables are used in Exhibit [[7]].
[3] Standard errors in brackets. + and * denote statistical significance at the 10% and 5% level, respectively.

Exhibit E10c. Simple Logit Model Estimation Results
Pooling Four Questions

Dummy Variables	All Questions Pooled	Questions Pooled Q1-4	Q5-8	Q9-12	Q13-16
Operating System					
Android	0.632	0.628	0.733	0.542	0.640
	[0.030]*	[0.060]*	[0.062]*	[0.058]*	[0.061]*
Apple	0.754	0.742	0.839	0.653	0.795
	[0.030]*	[0.059]*	[0.061]*	[0.057]*	[0.060]*
Blackberry	-0.024	-0.056	0.090	-0.189	0.067
	[0.034]	[0.067]	[0.069]	[0.068]*	[0.068]
Screen Size					
3.5 inch	-0.327	-0.365	-0.353	-0.286	-0.301
	[0.026]*	[0.052]*	[0.053]*	[0.052]*	[0.053]*
4.0 inch	-0.112	-0.106	-0.146	-0.094	-0.106
	[0.025]*	[0.050]*	[0.051]*	[0.050]+	[0.051]*
Price					
300	-0.968	-0.910	-0.971	-0.931	-1.071
	[0.027]*	[0.055]*	[0.055]*	[0.055]*	[0.056]*
200	-0.432	-0.379	-0.499	-0.385	-0.472
	[0.024]*	[0.047]*	[0.048]*	[0.048]*	[0.048]*
Voice Commands					
None	-0.568	-0.534	-0.596	-0.581	-0.561
	[0.026]*	[0.051]*	[0.052]*	[0.052]*	[0.053]*
Dialing only	-0.418	-0.447	-0.456	-0.384	-0.379
	[0.025]*	[0.050]*	[0.051]*	[0.050]*	[0.050]*
Multitasking					
1 app at a time	-0.500	-0.462	-0.552	-0.537	-0.450
	[0.027]*	[0.053]*	[0.055]*	[0.054]*	[0.054]*
Up to 5 apps	-0.019	-0.031	-0.023	-0.023	-0.005
	[0.024]	[0.049]	[0.049]	[0.049]	[0.050]
Availability of Applications					
6,000 apps	-0.287	-0.257	-0.301	-0.330	-0.266
	[0.029]*	[0.058]*	[0.059]*	[0.059]*	[0.059]*
40,000 apps	-0.147	-0.103	-0.149	-0.160	-0.182
	[0.028]*	[0.056]+	[0.057]*	[0.057]*	[0.058]*
100,000 apps	-0.032	-0.058	-0.052	0.015	-0.034
	[0.028]	[0.056]	[0.056]	[0.055]	[0.056]
Application Startup Time					
4 seconds	-0.498	-0.476	-0.575	-0.550	-0.382
	[0.026]*	[0.052]*	[0.054]*	[0.053]*	[0.053]*
2 seconds	-0.182	-0.164	-0.190	-0.232	-0.132
	[0.025]*	[0.049]*	[0.049]*	[0.049]*	[0.050]*
Log likelihood	-13,176.86	-3,356.19	-3,263.37	-3,307.26	-3,228.08
# Observations	43,864	11,068	11,024	10,976	10,796

Notes:
[1] Variables listed are dummy variables that carry the value of 1 for the feature level specified, and 0 otherwise. The ommited feature level is Windows for operating system, and the most preferred level, as predicted by economic theory, for the remaining features (4.5 inch screen size, price of $100, voice commands for dialing and texting, multitasking of up to 9 apps at a time, 300000 apps, and 0.2 second delay in application startup time).
[2] Results reported under "All Questions Pooled" differ from the simple logit results reported in Exhibit [[7]] because effects-coded variables instead of dummy variables are used in Exhibit [[7]].

Exhibit E11. Likelihood Ratio Tests of Identical Consumer Preference Across Choice Questions

Null Hypothesis	Unrestricted Log Likelihood	Restricted Log Likelihood	Chi-Squared Statistic	Degrees of Freedom (# Restrictions)	P-Value
Partworths identical across all 16 questions [1]	-13,072.74	-13,176.86	208.24	240	0.9317
Partworths for single question = Partworths for remaining questions pooled [2]					
Q1	-13,159.80	-13,176.86	34.12	16	0.0052
Q2	-13,172.10	-13,176.86	9.52	16	0.8905
Q3	-13,173.25	-13,176.86	7.22	16	0.9688
Q4	-13,172.42	-13,176.86	8.88	16	0.9183
Q5	-13,172.04	-13,176.86	9.64	16	0.8847
Q6	-13,170.06	-13,176.86	13.60	16	0.6285
Q7	-13,171.75	-13,176.86	10.22	16	0.8549
Q8	-13,168.52	-13,176.86	16.68	16	0.4066
Q9	-13,170.09	-13,176.86	13.54	16	0.6329
Q10	-13,166.67	-13,176.86	20.38	16	0.2036
Q11	-13,170.35	-13,176.86	13.02	16	0.6713
Q12	-13,171.75	-13,176.86	10.22	16	0.8549
Q13	-13,169.89	-13,176.86	13.94	16	0.6032
Q14	-13,173.27	-13,176.86	7.18	16	0.9696
Q15	-13,163.74	-13,176.86	26.24	16	0.0507
Q16	-13,172.96	-13,176.86	7.80	16	0.9546
Partworths for single questions identical within Group [3]					
Q1-4	-3,331.68	-3,356.19	49.02	48	0.4320
Q5-8	-3,244.94	-3,263.37	36.86	48	0.8789
Q9-12	-3,287.16	-3,307.26	40.20	48	0.7808
Q13-16	-3,208.96	-3,228.08	38.24	48	0.8422
Partworths identical across four groups [4]	-13,154.90	-13,176.86	43.92	48	0.6407

Notes:
[1] Unrestricted log likelihood is the sum of log likelihood across the 16 single-question models. Restricted log likelihood is the log likelihood for the model pooling all 16 questions.
[2] Unrestricted log likelihood is the sum of log likelihood for the single-question model and the log likelihood for the model pooling all questions except that single question. Restricted log likelihood is the log likelihood for the model pooling all 16 questions.
[3] Unrestricted log likelihood is the sum of log likelihood across the four single-question models. Restricted log likelihood is the log likelihood for the model pooling all four questions.
[4] Unrestricted log likelihood is the sum of log likelihood across the four pooled models pooling four questions. Restricted log likelihood is the log likelihood for the model pooling all 16 questions.

Exhibit E12. Distribution of Feature Levels Associated with the Chosen Phone Options

	Actual Phone Choice	Phone Choice Predicted by HB Model*	Phone Choice Predicted by Simple Logit Model**
Price			
$300	20.2%	19.7%	20.2%
$200	32.7%	32.4%	32.7%
$100	47.1%	47.9%	47.1%
Operating system brand			
Android	31.0%	31.5%	31.0%
Apple	34.6%	35.0%	34.6%
BlackBerry	17.0%	16.6%	17.0%
Windows	17.4%	16.9%	17.4%
Screen size			
3.5"	28.4%	28.2%	28.4%
4"	34.1%	34.2%	34.1%
4.5"	37.5%	37.6%	37.5%
Voice commands			
No voice commands	26.6%	26.2%	26.6%
Voice dialing only	30.1%	29.8%	30.1%
Voice dialing & texting	43.3%	44.0%	43.3%
Multitasking			
1 app at a time	24.6%	24.1%	24.6%
Up to 5 apps at a time	37.4%	37.6%	37.4%
Up to 9 apps at a time	38.0%	38.3%	38.0%
Availability of applications			
6,000	21.2%	21.1%	21.2%
40,000	24.3%	24.3%	24.3%
100,000	26.9%	26.9%	26.9%
300,000	27.6%	27.7%	27.6%
Application Startup Time			
4 seconds	26.0%	25.8%	26.0%
2 seconds	34.1%	34.1%	34.1%
.2 seconds	39.9%	40.1%	39.9%

Notes:

* Expected probability of choosing each option within each choice set is calculated using the estimated individual-level mean partworths provided by Prof. Shugan (FonKN_A_utilities.csv). The expected probability of choosing each attribute level within each choice set is then calculated by summing the expected probabilities of options offering the same attribute level. Numbers reported report averages of such probability across all choice sets.

** Expected probability of choosing each option within each choice set is calculated using partworth estimates from the simple logit model (Exhibit 10a, all questions pooled). The expected probability of choosing each attribute level within each choice set is then calculated by summing the expected probabilities of options offering the same attribute level. Numbers reported report averages of such probability across all choice sets.

Exhibit E13. Percentage of Respondents who Frequently Choose the Same Feature Level

	Same level chosen at least 50% of the time			Same level chosen at least 75% of the time		
	Actual Survey Responses	Predictions by HB Model*	Predictions by Simple Logit Model**	Actual Survey Responses	Predictions by HB Model*	Predictions by Simple Logit Model**
Price						
$300	3.6%	1.0%	0.0%	0.1%	0.1%	0.0%
$200	12.6%	7.8%	0.4%	0.5%	0.5%	0.0%
$100	41.5%	39.4%	20.0%	14.5%	13.6%	0.1%
Operating system brand						
Android	20.4%	19.5%	0.4%	10.2%	10.1%	0.0%
Apple	23.3%	22.6%	0.4%	14.0%	14.4%	0.0%
BlackBerry	5.1%	4.1%	0.0%	1.8%	1.9%	0.0%
Windows	4.3%	2.9%	0.0%	1.0%	0.9%	0.0%
Screen size						
3.5"	4.3%	1.4%	0.1%	0.4%	0.4%	0.0%
4"	10.8%	5.2%	0.4%	0.4%	0.1%	0.0%
4.5"	19.8%	13.1%	1.1%	2.0%	1.4%	0.0%
Voice commands						
No voice commands	6.8%	3.6%	0.0%	1.3%	1.0%	0.0%
Voice dialing only	9.6%	5.5%	0.1%	0.5%	0.1%	0.0%
Voice dialing & texting	33.5%	30.9%	5.2%	13.0%	11.9%	0.3%
Multitasking						
1 app at a time	4.7%	2.3%	0.1%	0.3%	0.1%	0.0%
Up to 5 apps at a time	19.9%	13.8%	1.1%	1.0%	0.6%	0.0%
Up to 9 apps at a time	22.4%	17.0%	1.1%	1.4%	0.6%	0.0%
Availability of applications						
6,000	1.4%	0.5%	0.1%	0.1%	0.1%	0.0%
40,000	2.8%	0.8%	0.0%	0.3%	0.1%	0.0%
100,000	3.3%	1.4%	0.1%	0.4%	0.4%	0.0%
300,000	6.1%	2.6%	0.1%	0.3%	0.1%	0.0%
Application Startup Time						
4 seconds	4.1%	2.6%	0.1%	0.0%	0.0%	0.0%
2 seconds	14.2%	6.9%	0.5%	0.8%	0.6%	0.0%
.2 seconds	26.3%	21.3%	1.9%	5.2%	3.4%	0.0%

Notes:

* Expected probability of choosing each option within each choice set is calculated using the estimated individual-level mean partworth provided by Prof. Shugan (FonKN_A_utilities.csv). The expected probability of choosing each attribute level within each choice set is then calculated by summing the expected probabilities of options offering the same attribute level. Such probabilities are further summed across the choice sets of each respondent to calculate the expected number of times that the respondent is expected to choose each attribute level.

** Expected probability of choosing each option within each choice set is calculated using partworth estimates from the simple logit model (Exhibit 10a, all questions pooled). The expected probability of choosing each attribute level within each choice set is then calculated by summing the expected probabilities of options offering the same attribute level. Such probabilities are further summed across the choice sets of each respondent to calculate the number of times that the respondent is expected to choose each attribute level.

Exhibit E14. Smartphone Application Availability by Operating System Brand

Operating System	October 2010[1]	November 2010[2]	December 2010[3]	January 2011[4]	March 2011[4]	August 2011[5]	Shugan's Base Case[6]	Amended Base Case
Android	100,000		130,000	151,036	206,143	250,000	100,000	100,000
Apple	300,000		300,000	303,113	333,214	425,000	300,000	300,000
Blackberry			18,000	19,439	26,771		40,000	6,000
Windows Phone 7		2,674		6,856	11,731	30,000	40,000	6,000

Notes and Sources:

1. Albanesius, Chloe, "Android Market Hits 100,000 Apps," PCMag, October 25, 2010 (http://www.pcmag.com/article2/0,2817,2371436,00.asp)
2. Distimo Report, November 2010.
3. Distimo Report, Full Year 2010.
4. Wauters, Robin, "There Are Now More Free Apps for Android than for the iPhone Distimo," TechCrunch, April 27, 2011 (http://techcrunch.com/2011/04/27/there-are-now-more-free-apps-for-android-than-for-the-ios-platform-distimo/).
5. McDougall, Paul, "Windows Phone 7 Apps Hit 30,000 Mark," InformationWeek, August 30, 2011 (http://www.informationweek.com/news/windows/microsoft_news/231600493)
6. Shugan Report, Exhibit 3a.

Exhibit F1. 23 Variables Used in Cockburn's Econometric Analysis

Variable	Description
Operating System (4)	
o_android	Operating System: Android
o_blackberry	Operating System: Blackberry
o_ios	Operating System: Apple
o_windows	Operating System: Windows
Design Phone Specs (15)	
battery_standby*	Battery life in standby mode
battery_talk*	Battery life in talk mode
linpack*	Linpack score (only for Android phones)
mem*	Memory (internal storage)
ttl_pixels*	Total number of pixels (effectively, screen size)
camera_autofocus	Camera with autofocus
data_tethering	Data tethering capable (connects phone to laptop for internet access)
dlna	Digital Living Network Alliance: enables media sharing over a home network
g4	4G phone
gps	GPS enabled
j2me	Uses J2ME (Java 2 Micro Edition)
mobile_hotspot	Mobile hotspot capable
touch_screen	Phone has a touch screen
oled	Organic LED (display type)
wifi	WI-FI capability
Non-Design Phone Specs (3)	
new	Whether the phone is new
unlocked	Whether the phone is unlocked
tom*	Time on the market (measured in months)
Market Characteristics (1)	
time	A monthly variable capturing market variations over time

Notes:
*variables marked with an asterisk are logged

Exhibit F2. Comparison of Likelihood Functions

Notation

$Bidder\ i$

$Auction\ j$

$y_{ij} = bid\ of\ bidder\ i\ at\ auction\ j$

$x_{ij} = explanatory\ variables\ associated\ with\ bidder\ i$

$n_j = number\ of\ bidders\ at\ auction\ j$

$m = number\ of\ auctions$

$z = number\ of\ bidders\ in\ dataset$

$SP_j = reservation\ price\ at\ auction\ j$

$WP_{ij} = winning\ price, equal\ to\ 1\ if\ bidder\ i\ wins\ auction\ j, 0\ otherwise$

$\sigma = standard\ deviation$

$b = vector\ of\ parameters\ that\ maximize\ Cockburn\ log\ likelihood\ function$

Set Up

$$U_{ij} = \frac{y_{ij} - x_{ij} * b}{\sigma} \qquad UR_{ij} = \frac{SP_{ij} - x_{ij} * b}{\sigma}$$

1. **Cockburn's Original Log Likelihood Function**

$$\sum_{j=1}^{m}\sum_{i=1}^{n_j}\left[\ln\left(PDFN(U_{ij}) * \left(\frac{1}{\sigma}\right) * \left(\frac{\mathbf{1}}{\boldsymbol{exp(y_{ij})}}\right) + (\mathbf{1} * \mathbf{10^{-10}})\right) + \boldsymbol{WP_{ij}} * \mathbf{ln(n_j!)} - WP_{ij} * \ln\left(\left(1 - CDFN(UR_{ij})\right)^{n_j} + (\mathbf{1} * \mathbf{10^{-10}})\right)\right]$$

2. **Leonard's Correction of Cockburn's Log Likelihood Function**

$$\sum_{j=1}^{m}\sum_{i=1}^{n_j}\left[\ln\left(PDFN(U_{ij}) * \left(\frac{1}{\sigma}\right)\right) - WP_{ij} * \ln\left(\left(1 - CDFN(UR_{ij})\right)^{n_j}\right)\right]$$

3. **Leonard's Truncated Regression Log Likelihood Function**

$$\sum_{j=1}^{m}\sum_{i=1}^{n_j}\left[\ln\left(PDFN(U_{ij}) * \left(\frac{1}{\sigma}\right)\right) - \ln\left(1 - CDFN(UR_{ij})\right)\right]$$

Items in red identify differences between Dr. Cockburn's likelihood function and that employed by Dr. Leonard. Equation 2 drops the fudge factor ($1*10^{-10}$) and the factors unrelated to the parameter estimates from Equation 1. Equation 3 is what Dr. Leonard actually estimates and he claims that Equations 2 and 3 produce identical results.

Exhibit F3. Estimated Coefficients from Competing Likelihood Functions

Variable	Cockburn (Proc IML) [1]	Leonard (Proc QLIM) [2]
Operating System		
o_android	0.165	0.157
o_blackberry	0.276	0.29
o_ios	0.883	0.841
o_windows	0.072	0.055
Design Phone Specs		
battery_standby*	0.033	0.054
battery_talk*	0.145	0.121
linpack*	0.077	0.076
mem*	0.041	0.043
ttl_pixels*	0.26	0.3
camera_autofocus	0.245	0.237
data_tethering	-0.049	-0.043
dlna	0.097	0.099
g4	0.166	0.175
gps	0.231	0.224
j2me	0.504	0.494
mobile_hotspot	0.04	0.038
touch_screen	0.068	0.059
oled	0.193	0.2
wifi	0.581	0.578
Non-Design Phone Specs		
new	0.242	0.249
unlocked	0.206	0.224
tom*	-0.209	-0.194
Market Characteristics		
time	-0.037	-0.037

Notes:
*variables marked with an asterisk are logged

Sources:
[1] Cockburn "econometric backup.xlsx"
[2] Leonard "exhibit 6.xlsx"

Exhibit F4. Cockburn's Auxiliary Regression Output

Results from a regression of linpack on RAM and processor speed.

Dependent Variable: ln_linpack
Number of Obs. Used: 13

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	3.8891	1.94455	5.64	0.023
Error	10	3.45057	0.34506		
Corrected Total	12	7.33967			

Root MSE: 0.58742
Dependent Mean: 2.55778
Coeff Var: 22.96586
R-Square: 0.5299
Adj R-Sq: 0.4358

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	1.09411	7.11529	0.15	0.8809
ln_ram	1	2.24781	0.72235	3.11	0.011
ln_processor	1	-1.8656	1.40286	-1.33	0.2131

Notes:
Regression uses data on 13 Android phone models.

Exhibit F5. Alternative Specifications Including Leonard's Next Generation Variables

	Dr. Leonard's Next Generation Model		Alternative 1		Alternative 2		Alternative 3	
	[1]		[2]		[3]		[4]	
Operating System								
o_android	**0.194**	***	**-0.080**		**0.058**		**0.050**	
o_blackberry	**0.310**	***	**0.371**	***	**0.361**	***	**0.348**	***
o_ios	**0.848**	***	**0.743**	***	**0.796**	***	**0.783**	***
o_windows	**0.054**		**0.047**		**0.052**		**0.061**	
Design Phone Specs								
battery_standby*	**0.048**		**-0.003**		**0.023**		**0.005**	
battery_talk*	**0.193**	***	**0.276**	***	**0.292**	***	**0.235**	***
linpack*	**0.055**	**	**0.131**	***	**0.093**	***	**0.108**	***
mem*	**0.049**	***	**0.056**	***	**0.057**	***	**0.058**	***
ttl_pixels*	**0.291**	***	**0.382**	***	**0.349**	***	**0.366**	***
camera_autofocus	**0.215**	***	**0.260**	***	**0.241**	***	**0.276**	***
data_tethering	**-0.041**		**-0.103**	***	**-0.068**	*	**-0.064**	*
dlna	**0.082**	***	**0.065**	***	**0.068**	***	**0.075**	***
g4	**0.221**	***	**0.278**	***	**0.275**	***	**0.251**	***
gps	**0.255**	***	**0.353**	***	**0.369**	***	**0.379**	***
j2me	**0.475**	***	**0.488**	***	**0.472**	***	**0.504**	***
mobile_hotspot	**-0.015**		**0.068**	*	**0.001**		**0.042**	
touch_screen	**0.081**	***	**0.082**	***	**0.081**	***	**0.057**	**
oled	**0.204**	***	**0.215**	***	**0.242**	***	**0.231**	***
wifi	**0.564**	***	**0.673**	***	**0.639**	***	**0.675**	***
Non-Design Phone Specs								
new	**0.251**	***			**0.277**	***	**0.276**	***
next_gen	**0.170**	***	**0.118**	***	**0.171**	***	**-0.124**	***
unlocked	**0.224**	***	**0.241**	***	**0.219**	***	**0.218**	***
next_gen_out*	**-0.050**	***	**-0.062**	***	**-0.063**	***		
tom*	**-0.151**	***						
Market Characteristics								
time	**-0.035**	***	**-0.046**	***	**-0.042**	***	**-0.046**	***
Regression Specific								
intercept	**-0.281**		**-1.989**	***	**-1.951**	***	**-1.978**	***
schwartz criterion	**381954.089**	***	**383116.489**	***	**382125.275**	***	**382271.426**	***

Notes:
*variables marked with an asterisk are logged
[1] Dr. Leonard's model includes next_generation, ln_next_gen_out, ln_tom, and new variables
[2] Alternative 1 includes next_generation and ln_next_gen_out
[3]. Alternative 2 includes next_generation, ln_next_gen_out, and new
[4] Alternative 3 includes next_generation and new

Source:
Leonard "exhibit6.xls"

Exhibit F6. Estimated Coefficients Using Only Winning Bids

Variable	Cockburn (Proc IML)	Winning Bid (Proc QLIM)
Operating System		
o_android	0.165	0.111
o_blackberry	0.276	0.340
o_ios	0.883	1.085
o_windows	0.072	0.119
Design Phone Specs		
battery_standby*	0.033	0.061
battery_talk*	0.145	0.096
linpack*	0.077	0.159
mem*	0.041	0.038
ttl_pixels*	0.260	0.364
camera_autofocus	0.245	0.274
data_tethering	-0.049	-0.060
dlna	0.097	0.153
g4	0.166	0.028
gps	0.231	0.283
j2me	0.504	0.573
mobile_hotspot	0.040	0.040
touch_screen	0.068	0.065
oled	0.193	0.208
wifi	0.581	0.630
Non-Design Phone Specs		
new	0.242	0.259
unlocked	0.206	0.187
tom*	-0.209	-0.146
Market Characteristics		
time	-0.037	-0.046
Model Characteristics		
intercept	0.697	0.025

Notes:
*variables marked with an asterisk are logged

Source:
Cockburn "econometric backup.xlsx"

Exhibit F7. Number of Applications Available by Operating System

Operating System	Date	Number of Apps Available	Source
Android	May 1, 2009	5,000	http://androinica.com/2009/09/android-market-has-10000-apps-many-of-which-dont-appeal-to-users/
Android	September 7, 2009	10,000	http://androinica.com/2009/09/android-market-has-10000-apps-many-of-which-dont-appeal-to-users/
Android	December 15, 2009	20,000	http://techcrunch.com/2009/12/15/android-market-20000-apps/
Android	March 16, 2010	30,000	http://techcrunch.com/2010/03/16/google-android-market-now-serving-30000-apps/
Android	July 15, 2010	70,000	http://allthingsd.com/20100715/googles-q2-may-not-wow-investors-revenue-in-line-eps-light/
Android	October 25, 2010	100,000	http://www.androidpolice.com/2010/10/25/android-market-officially-reaches-100000-applications/
Android	February 15, 2011	150,000	http://www.androidcentral.com/150k-apps-android-market-tripled-9-months
Android	April 1, 2011	200,000	http://www.distimo.com/blog/2012_01_google-android-market-tops-400000-applications/
Android	August 1, 2011	300,000	http://www.distimo.com/blog/2012_01_google-android-market-tops-400000-applications/
Android	January 3, 2012	400,000	http://www.distimo.com/blog/2012_01_google-android-market-tops-400000-applications/
iOS	September 9, 2008	3,000	http://www.padgadget.com/2010/05/01/how-many-ipad-apps-are-there/
iOS	February 28, 2008	6,000	http://www.148apps.com/news/wowza-30000-apps-itunes-app-store/
iOS	November 29, 2008	10,000	http://www.148apps.com/news/app-store-total-tops-10000/
iOS	March 26, 2009	30,000	http://www.148apps.com/news/wowza-30000-apps-itunes-app-store/
iOS	August 5, 2009	65,000	http://mashable.com/2009/08/05/flurry-iphone-apps/
iOS	October 27, 2009	100,000	http://mashable.com/2009/10/27/iphone-100000-apps/
iOS	May 3, 2010	200,000	http://appadvice.com/appnn/2010/05/ipadbigsales
iOS	November 22, 2010	300,000	http://www.apple.com/pr/library/2010/11/22Apples-iOS-4-2-Available-Today-for-iPad-iPhone-iPod-touch.html
iOS	March 15, 2011	350,000	http://148apps.biz/app-store-metrics/?mpage=appcount
iOS	July 1, 2011	400,000	http://148apps.biz/app-store-metrics/?mpage=appcount
Windows	December 1, 2010	5,000	http://allaboutwindowsphone.com/news/item/13913_Windows_Phone_Marketplace_pass.php
Windows	February 1, 2011	10,000	http://allaboutwindowsphone.com/news/item/13913_Windows_Phone_Marketplace_pass.php
Windows	May 1, 2011	20,000	http://allaboutwindowsphone.com/news/item/13913_Windows_Phone_Marketplace_pass.php
Windows	August 1, 2011	30,000	http://allaboutwindowsphone.com/news/item/13913_Windows_Phone_Marketplace_pass.php
Windows	November 16, 2011	40,000	http://allaboutwindowsphone.com/news/item/13913_Windows_Phone_Marketplace_pass.php
Windows	December 27, 2011	50,000	http://allaboutwindowsphone.com/news/item/13913_Windows_Phone_Marketplace_pass.php
Windows	January 23, 2012	60,000	http://freshinfos.com/2012/01/23/windows-market-hits-60000-apps-milestone/
BlackBerry	July 8, 2009	2,000	http://www.berryreview.com/2009/07/08/blackberry-app-world-hits-2000-apps-opening-up-soon-in-more-countries/
BlackBerry	February 18, 2010	5,000	http://www.zdnet.com/blog/btl/rims-growing-app-collection-bolsters-my-opinion-of-blackberry/30933
BlackBerry	September 7, 2010	10,000	http://crackberry.com/blackberry-app-world-surpasses-10-000-apps-we-head-devcon
BlackBerry	January 18, 2011	17,000	http://mobilesyrup.com/2011/01/18/blackberry-app-word-seeing-2-millions-apps-downloaded-every-day/
BlackBerry	February 14, 2011	20,000	http://mobilesyrup.com/2011/02/14/rim-there-are-over-20000-blackberry-apps-available-today/
BlackBerry	October 6, 2011	28,761	http://nerdberry.net/2011/10/06/new-milestone-for-blackberry-app-world/

Notes:
Number of Applications is set to 100 for time period before first available date and for phones categorized as "Other_OS".

Exhibit F8. Enhanced Model Including Application and Voice Control Variables

	Estimate	95% Confidence Interval		Significance Level
Operating System				
o_android	-0.437	-0.635	-0.241	***
o_blackberry	-0.133	-0.274	-0.004	**
o_ios	0.220	0.045	0.400	**
o_windows	-0.236	-0.334	-0.145	***
Design Phone Specs				
battery_standby*	0.045	-0.010	0.095	
battery_talk*	0.207	0.117	0.299	***
linpack*	0.077	0.028	0.127	***
mem*	0.049	0.039	0.059	***
ttl_pixels*	0.315	0.271	0.357	***
camera_autofocus	0.143	0.102	0.186	***
data_tethering	-0.067	-0.138	0.005	*
dlna	0.108	0.064	0.150	***
g4	0.202	0.137	0.271	***
gps	0.252	0.192	0.313	***
j2me	0.487	0.409	0.560	***
mobile_hotspot	0.028	-0.047	0.104	
touch_screen	0.074	0.027	0.120	***
oled	0.237	0.191	0.283	***
voice	0.190	0.135	0.248	***
wifi	0.577	0.536	0.618	***
Non-Design Phone Specs				
new	0.253	0.227	0.278	***
unlocked	0.224	0.195	0.250	***
tom*	-0.162	-0.193	-0.133	***
Market Characteristics				
time	-0.049	-0.053	-0.045	***
apps*	0.069	0.048	0.091	***
Regression Specific				
intercept	-0.574	-1.261	0.091	*
schwartz_criterion	381,883	376,309	387,401	***

Notes:
*variables marked with an asterisk are logged
See Exhibit F7 for sources of number of applications

Exhibit F9. Change in Willingness-to-Pay from Reduction in Linpack Score

Enhanced Model

Android Phone Model	Average Price ($)		Reduction in Linpack Score (%)	Change of Willingness-to-Pay ($)	
	2010	2011		2010	2011
HTC Droid Incredible	$338.44	$191.82	80%	-$20.82	-$11.80
HTC Evo 4G	$357.90	$292.79	80%	-$22.02	-$18.01
HTC G2	$396.53	$311.28	80%	-$24.40	-$19.15
HTC My Touch 4G	$388.77	$340.12	80%	-$23.92	-$20.93
HTC Nexus One	$479.36	$322.33	80%	-$29.49	-$19.83
HTC Thunderbolt	-	$460.64	80%	-	-$28.34
Motorola Atrix 4G	-	$547.78	80%	-	-$33.70
Motorola Droid	$238.13	$124.87	80%	-$14.65	-$7.68
Motorola Droid 2	$331.25	$253.13	80%	-$20.38	-$15.57
Motorola Droid X	$397.74	$290.51	80%	-$24.47	-$17.87
Samsung Epic 4G	$341.24	$280.60	80%	-$20.99	-$17.26
Samsung Fascinate	$328.01	$228.64	80%	-$20.18	-$14.07
Samsung Nexus S	$614.95	$519.94	80%	-$37.83	-$31.99

Notes:

1. Reduction in willingness to pay for each Android phone is determined based on an 80% shock of the Linpack score, calculated as [Coefficient on Linpack score * Percentage Reduction in Linpack score * Average selling price for the smartphone].

2. An 80% drop in the Linpack score leads to roughly a 6% drop in the willingness to pay for each phone.

Sources:

Average Price from Cockburn Exhibit C-7

Smartphone auction data from eBay.

Phone characteristics data from Phone Scoop (http://www.phonescoop.com), and where unavailable from Phone Scoop, manufacturer websites, phone reviews, http://pdadb.net/index.php?m=search and http://www.phonearena.com/phones.

Exhibit F10. Change in Willingness-to-Pay from Reduction in Number of Apps Available
Enhanced Model

			6,000 Apps Scenario				10,000 Apps Scenario			
	Average Price ($)		Reduction in Applications (%)		Change of WTP ($)		Reduction in Applications (%)		Change of WTP ($)	
Android Phone Model	**2010**	**2011**	**2010**	**2011**	**2010**	**2011**	**2010**	**2011**	**2010**	**2011**
HTC Droid Incredible	338.44	191.82	84%	96%	-19.63	-12.78	73%	93%	-17.06	-12.42
HTC Evo 4G	357.90	292.79	84%	96%	-20.76	-19.51	73%	93%	-18.04	-18.97
HTC G2	396.53	311.28	84%	96%	-23.00	-20.74	73%	93%	-19.99	-20.16
HTC My Touch 4G	388.77	340.12	84%	96%	-22.55	-22.66	73%	93%	-19.60	-22.03
HTC Nexus One	479.36	322.33	84%	96%	-27.81	-21.47	73%	93%	-24.17	-20.88
HTC Thunderbolt	-	460.64	84%	96%	-	-30.69	73%	93%	-	-29.84
Motorola Atrix 4G	-	547.78	84%	96%	-	-36.50	73%	93%	-	-35.48
Motorola Droid	238.13	124.87	84%	96%	-13.81	-8.32	73%	93%	-12.00	-8.09
Motorola Droid 2	331.25	253.13	84%	96%	-19.21	-16.86	73%	93%	-16.70	-16.40
Motorola Droid X	397.74	290.51	84%	96%	-23.07	-19.35	73%	93%	-20.05	-18.82
Samsung Epic 4G	341.24	280.60	84%	96%	-19.79	-18.70	73%	93%	-17.20	-18.18
Samsung Fascinate	328.01	228.64	84%	96%	-19.03	-15.23	73%	93%	-16.54	-14.81
Samsung Nexus S	614.95	519.94	84%	96%	-35.67	-34.64	73%	93%	-31.00	-33.68

Notes:
1. Average Price from Cockburn Exhibit C-7
2. Reduction in willingness to pay for each Android phone is determined based on the average percent reduction in number of applications based on caps at 6,000, 10,000, 20,000, and 40,000 apps, calculated as [Coefficient on *ln_apps* Variable * Percentage Reduction in Number of Applications * Average selling price for the smartphone].

Sources:
See Exhibit F-7 for Applications data
Smartphone auction data from eBay.
Phone characteristics data from Phone Scoop (http://www.phonescoop.com), and where unavailable from Phone Scoop, manufacturer websites, phone reviews, http://pdadb.net/index.php?m=search and http://www.phonearena.com/phones.

Exhibit F10. Change in Willingness-to-Pay from Reduction in Number of Apps Available
Enhanced Model

20,000 Apps Scenario				40,000 Apps Scenario			
Reduction in Applications (%)		Change of WTP ($)		Reduction in Applications (%)		Change of WTP ($)	
2010	2011	2010	2011	2010	2011	2010	2011
45%	87%	-10.63	-11.54	23%	73%	-5.28	-9.76
45%	87%	-11.25	-17.61	23%	73%	-5.59	-14.90
45%	87%	-12.46	-18.72	23%	73%	-6.19	-15.84
45%	87%	-12.22	-20.46	23%	73%	-6.07	-17.31
45%	87%	-15.06	-19.39	23%	73%	-7.49	-16.40
45%	87%	-	-27.71	23%	73%	-	-23.44
45%	87%	-	-32.95	23%	73%	-	-27.88
45%	87%	-7.48	-7.51	23%	73%	-3.72	-6.35
45%	87%	-10.41	-15.22	23%	73%	-5.17	-12.88
45%	87%	-12.50	-17.47	23%	73%	-6.21	-14.78
45%	87%	-10.72	-16.88	23%	73%	-5.33	-14.28
45%	87%	-10.31	-13.75	23%	73%	-5.12	-11.64
45%	87%	-19.32	-31.27	23%	73%	-9.60	-26.46