

# EXHIBIT 13

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14  
 15 **UNITED STATES DISTRICT COURT**  
 16 **NORTHERN DISTRICT OF CALIFORNIA**  
 17 **OAKLAND DIVISION**

19 **IN RE FLASH MEMORY ANTITRUST**  
**LITIGATION**  
 20  
 21  
 22 **This Document Relates to:**  
 23 **ALL DIRECT PURCHASER ACTIONS**

Case No. C07-0086 SBA  
**REPLY DECLARATION OF**  
**ROGER G. NOLL**  
 Date: October 20, 2009  
 Time: 1:00 p.m.  
 Judge: Sandra Brown Armstrong  
 Courtroom: 1, 4th Floor

24  
 25 **REDACTED VERSION**  
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UNITED STATES DISTRICT COURT  
NORTHERN DISTRICT OF CALIFORNIA

IN RE FLASH MEMORY ANTITRUST  
LITIGATION

Case No. CO7-0086-SBA

This Document Relates to:

ALL DIRECT PURCHASER ACTIONS

**REPLY DECLARATION OF ROGER G. NOLL**

My name is Roger G. Noll, and I reside in Palo Alto, California. Previously I submitted an expert report (*Declaration of Roger G. Noll*, henceforth *Noll Report*) in this litigation dealing with whether the economic evidence that would be used to establish liability and to prove damages in this matter would be predominantly common to all members of the proposed class. That report contains my professional background and experience in antitrust economics and the economics of the information technology sector of the economy.

**ASSIGNMENT**

Attorneys for the direct purchaser plaintiffs in this matter have asked me to review the *Declaration of Michael C. Keeley, Ph. D., in Support of Defendants' Joint Opposition to Direct Purchaser Plaintiffs' Motion for Class Certification* (henceforth *Keeley Report*) and to determine whether the evidence and analysis in that report cause

me to alter any of the conclusions that I reached in the *Noll Report*.

In carrying out this assignment, I have read the defendants' submissions in opposition to certification of the direct purchaser class, including the *Keeley Report*, *Declaration of Erik Aldana*, *Declaration of Juseon Kim*, and *Defendants' Joint Opposition to Direct Purchaser Plaintiff Timothy Chanda's Motion for Class Certification*. I also considered the depositions of Erik Aldana, Doug Hauck, Michael Keeley, and Juseon Kim. I also considered other material that is referenced in footnotes in this declaration. In addition, just prior to and after the deadline for my previous report, the defendants produced additional transactions data and documentation of transactions records for NAND flash products, including corrections of errors in their earlier submissions, the last of which was received in September. Using the expanded and corrected transactions data, I have updated and expanded the data analysis in my prior report. In preparing this reply declaration, I have been assisted by economists at OSKR.

## SUMMARY AND CONCLUSIONS

The purpose of this section is to summarize the analysis and conclusions that are presented in the main body of this report. The basis for these conclusions, including supporting references, is contained in subsequent sections of this report.

The *Keeley Report* makes the following arguments in support of the conclusion that the direct purchaser class should not be certified. [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

The *Keeley Report* also contains numerous criticisms of the *Noll Report*. The most important of these are that I do not demonstrate that different types of products and products sold by different defendants have a common price formulation process, the methods I use are unscientific and unreliable, and the analysis of issues that affect the likely success of a cartel does not support the conclusion that price collusion could be effective in this industry.

Dr. Keeley's conclusions are all testable hypotheses using conventional analytical methods in economics. Although Dr. Keeley did not actually test these hypotheses, they can be formally tested using the data that he had available to him and selectively reproduced in the *Keeley Report*. In this report, I use conventional economic methods to test Dr. Keeley's conclusions. I find that none of the conclusions in the *Keeley Report* are valid, and as a result nothing in the *Keeley Report* causes me to alter my conclusions.

One reason that Dr. Keeley and I reach different conclusions is that we apparently differ in our interpretations of the meaning of the requirement that "predominantly common factors" determine prices among class members. Dr. Keeley believes that any price difference between two buyers or two products is sufficient to cause the price

setting process to be individualized between them. By comparison, the conclusions from my analysis, as in the DRAM and SRAM litigation, are based on whether common factors explain most of the differences in prices among customers and products.

Another reason that Dr. Keeley and I reach different conclusions is that Dr. Keeley makes crucial errors of economic analysis. Among these errors are invalid methods for calculating demand elasticity, defining relevant markets, measuring market concentration, characterizing what is known about the effect of costs on prices, and manipulating the possible range of variation of prices on graphs to emphasize differences and minimize commonalities. Each of these errors biases the results of Dr. Keeley's analysis in favor of finding that individual factors are important in determining prices.

[REDACTED]

I also do not agree with Dr. Keeley that Moore's Law and learning by doing can be disregarded as factors causing the price formulation process to be common among class members.<sup>1</sup> Whereas all semiconductor products obey Moore's Law and experience learning by doing, how these factors affect costs and prices is not the same for all semiconductors. Moore's Law works more rapidly in flash memory than in other semiconductor technologies, and learning by doing occurs only as experience is gained with a particular technical family of products. [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

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<sup>1</sup> Moore's Law states that the number of circuits that can be included on a semiconductor of given size doubles every 18-24 months, which implies reduced cost per unit of capacity. Learning by doing refers to cost reduction that arises from manufacturing experience, and occurs because as manufacturers gain production experience with a given technical generation of a chip, less silicon is wasted in making bad chips.





collusive activity. Obviously, without complete discovery, the *Complaint* cannot provide a definitive history of the conspiracy. In any case, the source of disagreement between us on this issue is that I accepted and Dr. Keeley rejected the validity of the *Complaint* for purposes of determining whether the economic evidence pertinent to establishing liability and damages would involve predominantly common proof.

[REDACTED]

Dr. Keeley's criticisms of my report also are invalid.

First, he mischaracterizes the methods and results in my report. The report provides evidence on the extent of commonality of the price formulation process across product, sellers and buyers.

[REDACTED]

[REDACTED]

Third, his criticism of my discussion of cartel-facilitating practices amounts to a disagreement that these conditions are present or facilitate a cartel. His criticism does not address whether the methods for proving the existence (or non-existence) of cartel-facilitating practices is common to all class members, which they clearly are. Moreover, his discussions of entry barriers and contract forms present no evidence that was not discussed in my report and contain no economic analysis.

[REDACTED]

[REDACTED]

Our disagreements are over the implications of these facts. In particular, Dr. Keeley opines that collectively these facts imply that prices are formulated primarily on the basis of the individual characteristics of each purchaser so that the impact of collusion on class members cannot be proved by common means, whereas I conclude that some of these areas of agreement between us support the predominance of common factors in determining impact, while others empirically do not explain enough variation in prices to destroy the predominance of common factors in determining prices. Because Dr. Keeley provides no valid evidence to support his conclusions, I see no reason to alter my conclusion that predominantly common methods can prove liability and damages.

The remainder of this report fleshes out these issues and provides the basis for my conclusions. In undertaking my analysis, I have redone and extended Dr. Keeley's Exhibits. Because Dr. Keeley based his conclusions in part on comparisons of two or three customers or products, and because this case involves thousand of products and hundreds of buyers, the data analysis that supports my conclusions is necessarily enormous. In this report, I present some tables and figures to illustrate the content of this analysis. The complete data analysis that forms the basis for my conclusions is submitted in a series of backup files.

Backup File A contains [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

Backup File B contains [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

Backup File C contains [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

Backup File D contains [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

## AREAS OF AGREEMENT

Dr. Keeley and I apparently agree on some key factual and analytical points that are relevant for determining whether the proof of liability and damages for class members would be predominantly common to all class members. In some cases, our agreement is explicit in that we say essentially the same thing or Dr. Keeley correctly states that we agree.<sup>2</sup> In other cases, I infer agreement with the *Noll Report* from the absence of disagreement or criticism, although I recognize that Dr. Keeley may not agree and his absence of criticism may indicate only that he thinks that I am incorrect but the issue is unimportant. This section identifies both categories of agreements, and briefly states the significance of each for determining commonality of impact and damages.

### *Explicit Agreement*

Dr. Keeley and I generally agree about the history and technology of flash memory. We agree that flash memory has undergone rapid technological progress, generally obeys Moore's Law, and exhibits economies of scale due to high fixed costs and learning by doing. We agree that the most important implication of these facts is that both unit costs and prices of all flash memory products have declined rapidly over time, notwithstanding occasional upticks in price during period of excess demand or when a new technology is introduced. I regard these facts as demonstrating that all flash products have a strong element of commonality in supply which facilitates jointly analyzing supply and demand for the entire family of raw flash memory products.

Dr. Keeley states that the commonality of the underlying technology is irrelevant

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<sup>2</sup> Dr. Keeley also sometimes claims that we agree when we do not. I discuss these points elsewhere in this report.

to the issue of common proof of liability and damages, and claims that conditions of supply differ among a large number of technical varieties of raw flash products. Dr. Keeley offers neither theoretical nor empirical analysis to support this assertion, and I find no basis in economics for even entertaining the idea that the commonality of supply arising from these underlying technical facts ought to be ignored in assessing whether collusion is likely to have a predominantly common effect among customers of different products.

[REDACTED]

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<sup>3</sup> *Keeley Report*, p. 34, and *Keeley Deposition*, pp. 100-02.



[REDACTED]

Dr. Keeley and I agree that there are two distinct categories of flash memory products – raw flash and finished flash – and that these products are not substitutes because raw flash is an input to finished flash. [REDACTED]

[REDACTED]

[REDACTED] Given this fact, the impact of collusion likely would be common across types of finished products. Dr. Keeley and I also agree that the *Complaint* does not allege collusion on finished products. The appropriate assumption regarding finished products is that the defendants are among a much larger number of sellers of finished products, and both individually and collectively lack market power in finished products. Competition in finished products implies that the proof of liability and damages regarding finished products involves measuring the impact of the monopoly overcharge in raw flash on the prices for finished products. [REDACTED]

[REDACTED]

***Implicit Agreement***

The *Noll Report* contains several facts and analysis that are not addressed in the *Keeley Report*. I infer that Dr. Keeley would have explicitly disagreed with these points if he thought that these were incorrect and important. Thus, I refer to these points as areas of implicit agreement, although I realize that Dr. Keeley may not fully agree.

***Contact***

[REDACTED]



[REDACTED]

*Negotiations and Contracts*

[REDACTED]

5

[REDACTED]

[REDACTED]

*The Effect of Vertical Integration*

[REDACTED]

*Collective Market Power*

The *Noll Report* observes that *per se* antitrust cases do not require proof of the relevant market or the presence of market power. Dr. Keeley does not directly dispute this point. My analysis of the ability of the defendants collectively to exercise market

power does not require that I identify precisely the relevant markets, but only that I show a method that would determine by common evidence whether, regardless of how these markets are defined, the defendants collectively enjoy market power. [REDACTED]

[REDACTED] Dr. Keeley does not dispute the facts, but argues that the data are meaningless because total raw flash production is not a relevant market.

Despite Dr. Keeley's criticism of my failure to define a market before attempting to measure market power, Dr. Keeley does not apply this criticism to himself. [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

The significance of this point is that Dr. Keeley has no basis for concluding, and in fact does not assert, that the defendants collectively lack market power. Beyond this, my analysis on this point explicitly stated that the purpose was to illustrate how methods of common proof could be used to establish market power, not to prove that market power was established. Proof of market power is inherently a matter to be determined by aggregate facts concerning the market, not the individual circumstances of each buyer,

[REDACTED]

*Barriers to Entry*

[REDACTED]

*Elasticity of Demand*

The *Noll Report* cites a well-known economic formula: the elasticity of demand for an input that has no substitutes equals the elasticity of demand for the final product

times the share of the input in the total cost of the downstream product. [REDACTED]

[REDACTED]

*Custom Products*

The *Noll Report* cites the criteria that were used in the SRAM litigation for identifying which products are custom products. [REDACTED]

[REDACTED]

*Regressions to Prove Impact and Damages*

The *Noll Report* explains how contract terms, technical characteristics, life-cycle effects, and quantity discounts can be incorporated in a regression analysis that explains variation in prices across products and customers. [REDACTED]

[REDACTED]

**MEANING OF PREDOMINANTLY COMMON PROOF**

Dr. Keeley and I have different understandings of whether the process of price formulation is predominantly common to members of a proposed class. My understanding is that price formulation can be said to be a predominantly common process if most of the variation in prices among consumers can be explained by a common formula. [REDACTED]

<sup>6</sup> Keeley Report, p. 67.  
<sup>7</sup> Keeley Deposition, pp. 212-14, 260-61.



[REDACTED]

**MISCHARACTERIZATIONS OF MY TESTIOMY**

The *Keeley Report* contains numerous passages that mischaracterize statements in either the *Noll Report* or my deposition. Here I will point out only some of them, focusing on the mischaracterizations that deal with issues that seem to me to be most important. I first quote the reference by Dr. Keeley, then explain why it is inaccurate and why this inaccuracy is important.

1. [REDACTED]

[REDACTED]









[REDACTED]

2. [REDACTED]

[REDACTED]

[REDACTED]

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<sup>13</sup> The basis for these tables is contained in Backup File A.



[REDACTED]

3. [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

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16 [REDACTED]

[REDACTED]

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<sup>17</sup> *Noll Deposition*, pp. 186-87.

<sup>18</sup> *Ibid.*, pp. 191-92.

<sup>19</sup> *Ibid.*, pp. 189-90.

<sup>20</sup> [REDACTED]

[REDACTED]

4. [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

5. [REDACTED]

[REDACTED]





6. [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

7. [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

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[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

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<sup>21</sup> *Noll Report*, p. 52.

<sup>22</sup> The full discussion is on pages 44-52 of the *Noll Report*.



[REDACTED]<sup>23</sup> Buyer power refers to a circumstance in which one buyer or a group of buyers has sufficient market power to force a reduction in the prices charged by sellers below the prices that otherwise would be the case, given seller concentration. A market in which one buyer enjoys market power is called a monopsony, and a market in which a small number of buyers can exercise market power is called an oligopsony. In general, the economics of demand-side market concentration, market power, and anticompetitive behavior by one or more buyers is symmetric to the analysis of these issues on the supply side.<sup>24</sup>

Whether a buyer or a seller has market power turns on the share of total output in a relevant market that is accounted for by that firm. To detect market power, the proper concentration measure is the share of firms in all production (sellers) or use (buyers) of products in a relevant market. [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED] The *Merger Guidelines* are unambiguous on this point.

“The Agency's identification of firms that participate in the

<sup>23</sup> *Keeley Report*, pp. 11-13, 35-37, Exhibits 11-14.

<sup>24</sup> See, for example, Roger G. Noll, “Buyer Power and Economic Policy,” *Antitrust Law Journal* 72(2) (2005), pp. 311-40, and the references therein.

relevant market begins with all firms that currently produce or sell in the relevant market. This includes vertically integrated firms to the extent that such inclusion accurately reflects their competitive significance in the relevant market...<sup>25</sup>

[REDACTED]

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<sup>25</sup> U. S. Department of Justice and Federal Trade Commission, *Horizontal Merger Guidelines*, Section 1.31.

<sup>26</sup> [REDACTED]

[REDACTED]

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<sup>27</sup> *Keeley Report*, p. 13 and Exhibit 17.

<sup>28</sup> Exhibit D contains revisions of many of the Exhibits from the *Keeley Report*, and preserves his numbering but follows each of his exhibit numbers with an N.

<sup>29</sup> [REDACTED]

[REDACTED]

*Market Definition*

Dr. Keeley believes that market definition issues are important in this litigation, despite the fact that in a *per se* case plaintiffs are not required to define the relevant market. His argument presumes that in a class action antitrust case, common proof of harm nevertheless hinges on all of the products in the case being part of the same relevant market. I disagree with this assumption in that I understand that the requirement for class certification is that the effect of the anticompetitive acts is predominantly common to all class members, which means that the effect of the anticompetitive acts on price can be calculated using a common formula. If supply and demand conditions for two distinct products, sold in different markets, are nevertheless sufficiently similar, a “direct effects” model can be used to estimate the effects of the anticompetitive acts on all class members. For this reason, I conclude that Dr. Keeley’s remarks about market definition are irrelevant. [REDACTED]

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<sup>30</sup> [REDACTED]

[REDACTED]

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<sup>31</sup> [REDACTED]

<sup>32</sup> *Keeley Report*, pp. 28-29.

<sup>33</sup> See <http://www.apple.com/ipod/compare-ipod-models/>, accessed September 14, 2009.

<sup>34</sup> See <http://www.apple.com/iphone/compare-iphones/>, accessed September 14, 2009.



[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED] More generally, the *Merger*

*Guidelines* state that supply substitution must be taken into account in defining markets and measuring market power.

“In addition, the Agency will identify other firms not currently producing or selling the relevant product in the relevant area as participating in the relevant market if their inclusion would more accurately reflect probable supply responses. These firms are termed “uncommitted entrants.” These supply responses must be likely to occur within one year and without the expenditure of significant sunk costs of entry and exit, in response to a ‘small but significant and nontransitory’ price increase.<sup>36</sup>

“If a firm has existing assets that likely would be shifted or extended into production and sale of the relevant product within one year, and without incurring significant sunk costs of entry and exit, in response to a ‘small but significant and nontransitory’

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<sup>35</sup> [REDACTED]

<sup>36</sup> *Merger Guidelines, supra*, Section 1.32.

increase in price for only the relevant product, the Agency will treat that firm as a market participant.<sup>37</sup>

“The Agency normally will calculate market shares for all firms (or plants) identified as market participants in Section 1.3 based on the total sales or capacity currently devoted to the relevant market together with that which likely would be devoted to the relevant market in response to a ‘small but significant and nontransitory’ price increase.”<sup>38</sup>

[REDACTED]

<sup>37</sup> *Ibid.*, Section 1.321.

<sup>38</sup> *Ibid.*, Section 1.41.

<sup>39</sup> [REDACTED]





[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

The class period in this case lasts over nine years, and during that time a great deal has changed to affect the demand for raw flash. The most obvious example is the enormous rate of technological progress in consumer electronic devices that make use of flash memory and improvements in the performance of raw NAND flash memory. Another important change is the effect of Moore's Law on miniaturization. Holding capacity fixed, the size of a raw flash chip falls in half roughly every year, which has made possible the invention of very small electronic devices that contain a very large amount of memory. As discussed in the *Noll Report*, nearly all of the growth in sales for flash memory is for use in products that did not exist at the beginning of the class period.

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]



[REDACTED]

More generally, economists broadly agree that in competitive markets, pass-through of changes in costs is near one hundred percent. The articles by Dennis Carlton do not refute this position. Neither of Professor Carlton's articles deal directly with the issue of cost pass-through. Instead, both are addressed to an issue in Keynesian macroeconomics, which is whether prices are rigid in that they do not change very frequently. This issue is important because if prices are rigid, they do not fall in response to a reduction in aggregate demand, and as a result prices do not adjust quickly enough to prevent a temporary fall in overall demand from becoming a recession. The responsiveness of price to changes in demand is not related to whether prices respond to changes in cost. Price rigidity could reflect the absence of pass-through of cost changes, but it also could occur if prices do not change quickly in response to changes in demand or if costs and demand are not changing.

[REDACTED]

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<sup>45</sup> Martin K. Perry, "Vertical Integration: Determinants and Effects," in Richard Schmalensee and Robert D. Willig, *Handbook of Industrial Organization*, North-Holland, 1989.

[REDACTED]

[REDACTED] Professor Carlton also finds that the frequency of price changes is negatively correlated with the magnitude of price changes, which means that price rigidity takes the form of less frequent but larger price changes.<sup>47</sup> This finding is consistent with the standard result from economic theory that changes in cost are passed through as changes in price, although at different speeds among industries.

Professor Carlton also states caveats to the findings that some prices are rigid. Professor Carlton points out that one source of price rigidity is contracts and other long-term business relationships, and that the time period he studies had very low inflation (and hence little change in average costs).<sup>48</sup> [REDACTED]

[REDACTED]

<sup>46</sup> Dennis W. Carlton, "The Rigidity of Prices," *American Economic Review* Vol. 76, No. 4 (September 1986), pp. 637-58 at p. 638.  
<sup>47</sup> *Ibid.*  
<sup>48</sup> *Ibid.*, pp. 638-39.  
<sup>49</sup> *Keeley Deposition*, pp. 257-58.  
<sup>50</sup> The industries that are included in Professor Carlton's study are steel, nonferrous metals, petroleum, rubber tires, paper, chemicals, cement, glass, truck motors, plywood, and household appliances. *Ibid.*, p. 641.  
<sup>51</sup> *Keeley Report*, p. 47, citing Dennis W. Carlton, "The Theory and the Facts of How Markets Clear: Is Industrial Organization Valuable for Understanding Macroeconomics?" in Richard Schmalensee and and Robert D. Willig, *Handbook of*



[REDACTED]

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*Industrial Organization*, North-Holland, pp. 909-46 at p. 916.  
<sup>52</sup> *Keeley Report*, p. 60, footnote 190, and repeated on p. 63, footnote 194.

<sup>53</sup> [REDACTED]



[REDACTED]

*The Gee-Whiz Graph*

[REDACTED]

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<sup>55</sup> Darrell Huff and Irving Geiss, *How to Lie with Statistics*, W. W. Norton, 1993 (reissue from 1954), Chapter 5, "The Gee-Whiz Graph," pp. 60-65. See also Edward R. Tufte, *The Visual Display of Quantitative Information*, 2<sup>nd</sup> Edition, Graphics Press, 1986, Chapter 2, "Graphical Integrity," pp. 53-59.

<sup>56</sup> [REDACTED]



[REDACTED]

*Imaginary Price Stability*

[REDACTED]

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<sup>57</sup> *Keeley Deposition*, p. 139.

[REDACTED]

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<sup>58</sup> *Keeley Deposition*, p. 67.

[REDACTED]

*Revising Misleading Graphs*

[REDACTED]

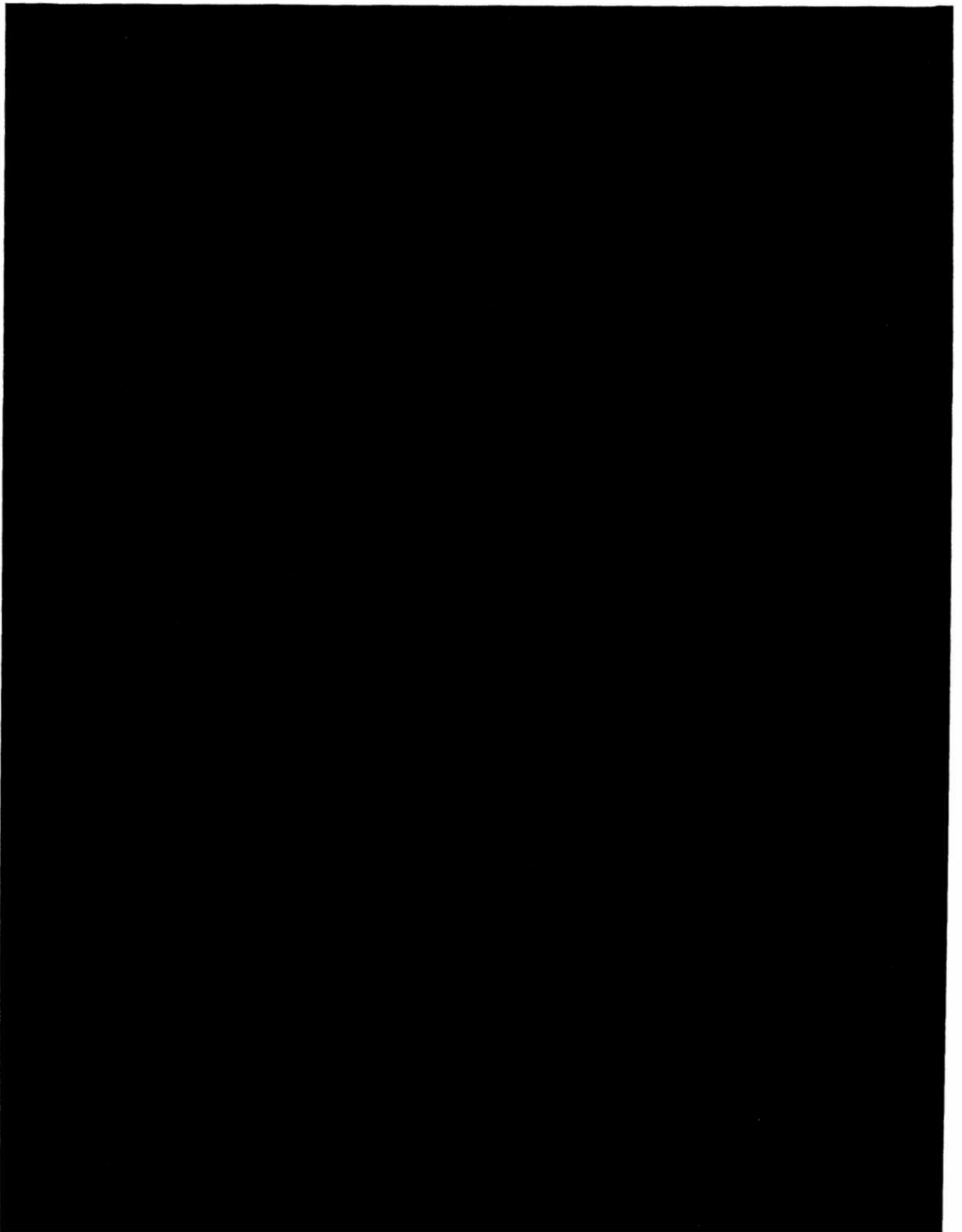
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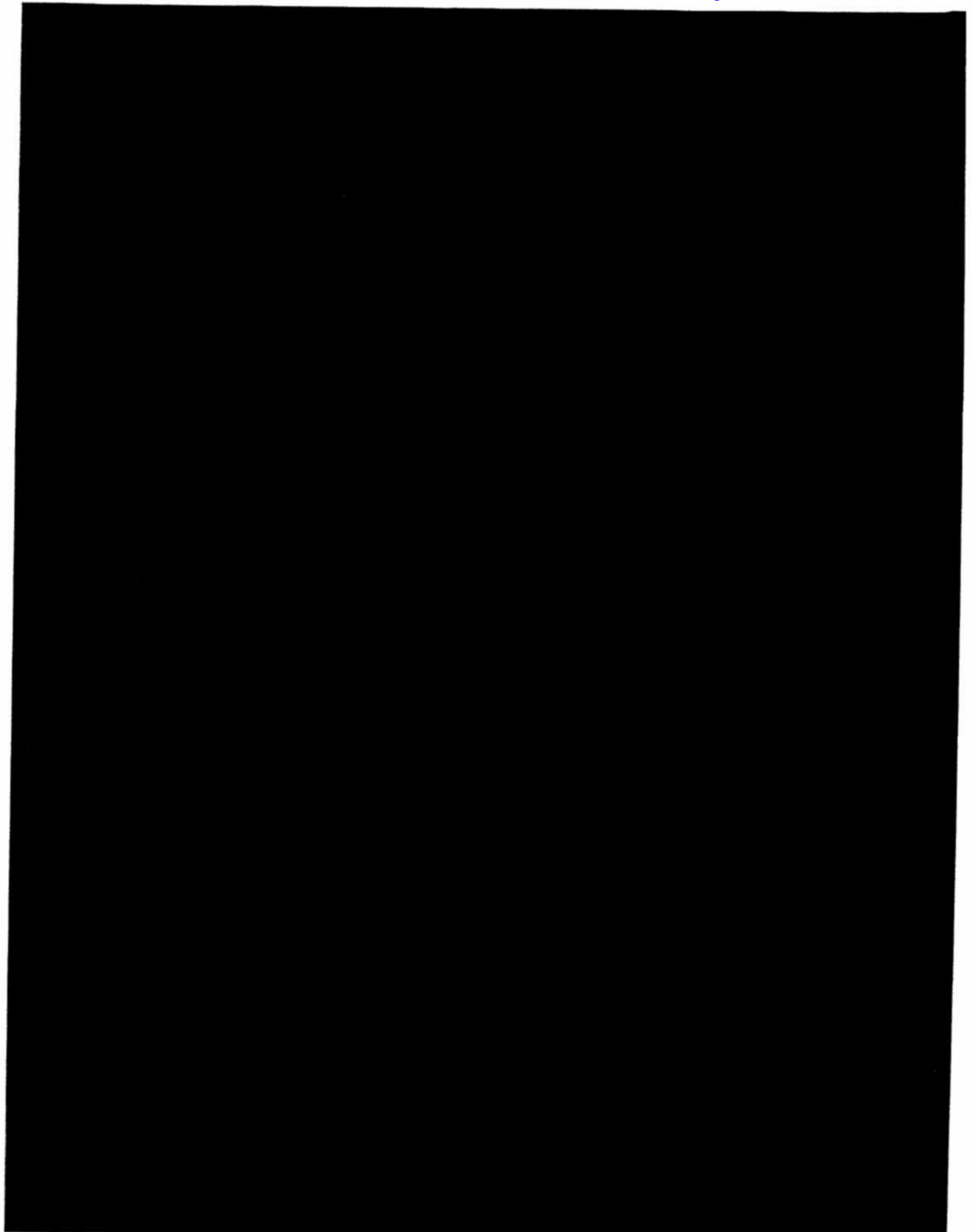
<sup>59</sup> [REDACTED]

<sup>60</sup> *Ibid.*, p. 67.

[REDACTED]







[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

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