

# Exhibit B

### **Qualifications and Background**

1. I received a Ph.D. degree in Economics from the University of California Los Angeles in 1977. I was an Associate Professor of Economics at the University of Washington until November of 2008 when I took early retirement. I taught classes in the government regulation of business, antitrust economics, and industrial organization at both the undergraduate and graduate levels for over thirty years. I continue to research and publish in these areas of economics and I have done so throughout my academic and consulting career. A curriculum vitae summarizing my academic experience and publications is included with this report.
2. I have been performing economic analysis in antitrust cases since 1976. Over the years, I have worked with the U.S. Department of Justice, the Federal Trade Commission, many state Attorneys General, and private attorneys on both the plaintiff and the defendant sides of cases. I have been qualified as an economic expert before federal courts, state courts, the Federal Trade Commission, and other federal and state regulatory agencies. I have studied allegations of price fixing and conspiracies in many industries including gasoline, residential doors, vitamins, nutritional feed additives, cigarettes, prescription drugs, infant formula, propane, carpets, Ivy League financial aid, corrugated containers, flat glass, ethyl propylene diene monomer (EPDM), parcel shipping, and salmon. I have evaluated damage methodologies and estimated damages using regression analyses in numerous situations and industries involving both monopoly and price fixing allegations. I have also studied the industrial organization of many high tech industries including main frame computers, mini computers, PC operating systems, computer microprocessors, and analog to digital chips.

My CV summarizes major cases I have worked on. I am charging the Department of Justice my government consulting rate of \$500 per hour for my work on this case.

**Assignment and Basis for Opinions**

3. This case concerns the allegation of price fixing through a series of meetings including meetings known as the Crystal Meetings. These meetings are discussed in detail below. The Crystal Meeting Participants included AU Optronics (AUO), Chi Mei Optoelectronics (CMO), Chunghwa Picture Tubes (CPT), HannStar, LG Display, and Samsung. I will refer to these companies hereafter as the "Crystal Meeting Participants." The Department of Justice reached plea agreements or amnesty agreements with all of the Crystal Meeting Participants except AUO.
4. I have been asked by attorneys for the Department of Justice to evaluate the overcharges on Liquid Crystal Displays (hereafter LCDs) from the alleged collusion of the Crystal Meeting Participants. In order to carry out this assignment, I have reviewed various court pleadings, depositions taken in the civil cases, documents from discovery, interviews of Crystal Meeting participants' employees, expert reports in the class certification phase of the civil cases, data received from LCD manufacturers, data from public sources, and trade and academic literature. I have also relied upon my training and background as an economist.

**Summary of Opinions**

5. From the evidence I have reviewed and the empirical analysis I have undertaken as explained in detail below, I have reached the opinions set forth in this report including the following:<sup>1</sup>

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<sup>1</sup> I understand that reciprocal discovery is forthcoming in the case, that AUO will cross examine the government's witnesses in the liability phase of the case, and also that AUO will be producing an economic expert report. I will review this and any other information that becomes available to me after the production of this report and revise my opinions if the opinions or the bases for the opinions are impacted by that review.

- A) Control of the sale of LCDs for use in notebooks, for use in monitors, and for use in TVs would allow a seller or set of sellers to set above competitive prices of the LCDs.
- B) AUO and the LCD manufacturers that have admitted guilt together had a substantial share of LCD sales, a share sufficient to collectively set above competitive prices.
- C) There are significant barriers to entry such that the Crystal Meeting Participants could raise prices above the competitive levels.
- D) During substantial portions of the period October 2001 through June 2006, AUO and the other Crystal Meeting Participants charged above competitive prices for LCDs.
- E) During the period October 2001 through June 2006, the Crystal Meeting Participants overcharged purchasers of LCDs over \$12 billion above competitive prices for LCD panels of 12 to 30 inch diagonal screen size.

### **The Economics of the LCD Industry**

6. Liquid crystal displays are thin, flat displays in which liquid crystals modulate light to produce an image.<sup>2</sup> In essence, an LCD arrays electrically modulated liquid crystal pixels in front of a light source; the pixels then selectively allow the light to pass through or to be blocked. LCDs are produced with a number of components.<sup>3</sup> LCD panels produce no light of their own; hence they require an external lighting source. This is typically done by fluorescent lamps contained in a “backlight module”.<sup>4</sup> The light from the backlight module then shines on specialized glass sheets (called Active Matrix Liquid Crystal Display Glass Substrates) that have liquid crystals between them. The sheets include polarizers, which cause light to pass in only one plane. An array of transistors is deposited on the glass sheets with each transistor corresponding to a “pixel.” Using Driver Integrated Circuits (ICs) to control the

<sup>2</sup> Histories of the development of LCDs include Castellano, *Liquid Gold: The Story of Liquid Crystal Displays and the Creation of an Industry*, World Scientific Publishing Co. (2005); Kawamoto, “The History of Liquid-Crystal Displays,” *Proceedings of the IEEE*, (April 2002). See also the Declaration of Yoong-Ki Min for LG Display ¶¶6-8; Sha, Chen, and Chen, “The Strategic Fit of Supply Chain Integration in the TFT-LCD Industry,” *Supply Chain Management: An International Journal*, 1996.

<sup>3</sup> A non-technical description of LCD production and components is provided in Credit Suisse First Boston, *Asia-Pacific TFT LCD Sector, Understanding the Food Chain*, 17 January 2005. See also AUO, *TFT-LCD Process*, at <http://www.auo.com/?sn=189&lang=en-US>.

<sup>4</sup> Very simple LCDs use a mirror to reflect ambient light. LED illuminated LCD panels are becoming more common.

electricity to each pixel, the light is either blocked or passes through and the brightness is determined. In addition, many LCDs use color filters (red, green and blue) to create a colored display.<sup>5</sup>

7. An LCD fabrication line (“fab”) operates using a particular size of glass sheets.<sup>6</sup> Newer fabs achieve greater efficiency by using larger glass sheets. Fabs are typically grouped into “generations” based on the glass size used. LCD fabs are very expensive to build. On average the capital costs for a state of the art LCD fab in 2005 (Gen 8) was about \$3.2 billion, and this increased to about \$4.6 billion for the latest generation Gen 10 fab. Table 1 summarizes the costs of various generation fabs.

8. LCDs were initially used in simple small displays such as in clocks, watches and calculators. In 1988, Sharp produced a 14 inch color LCD which could display a television image. Compared to the Cathode Ray Tube (CRT) displays which were dominant in use at the time, LCDs are lighter, thinner, and more energy efficient. LCDs are now used in a variety of applications. They are used for small displays in digital clocks and watches, calculators, telephones, cell phones, smart phones, instrument panels, and hand held video games. This case concerns larger LCDs 12 to 30 inches, used almost exclusively in notebook computers,

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<sup>5</sup> LCDs are also made that use a passive matrix (PM-LCD) rather than thin film transistor (TFT-LCD) technology. Passive matrix LCDs are much simpler to make but they have a slow response time and were not used for monitors, notebooks or TVs during the time period of interest. See AUO MDL 29024, 29052, 29093. LCD “panels” are sometimes used to refer to the glass-polarizer-filter-crystal component alone. See e.g., Sharp 30(b)(6) deposition of Hiroyuki Morimitsu, p. 18. An LCD module typically includes the backlight and the ICs. See e.g., the Chi Mei Optoelectronics 30(b)(6) deposition of Irene Ko, p. 70. Some in the industry do not distinguish LCD panels and LCD modules. See, e.g., the LG deposition 30(b)(6) of Yoong Ki Min, p. 30-31. My understanding is that all the defendants ship complete LCD modules including the backlight and ICs. See e.g., AU Optronics Form 20-F 2007, Chi Mei 2007 Annual Report, LG Philips LCD Form 2—F 2007. Throughout this report, I therefore refer to the complete module TFT-LCD using interchangeably LCD, LCD panel, or LCD module.

<sup>6</sup> I understand that a fab can be modified to handle somewhat smaller or larger sheets than designed for. See, e.g., [http://www.Samsung.com/nz/presscenter/pressrelease/global\\_pressrelaease.asp?seq=19970106\\_0000000462](http://www.Samsung.com/nz/presscenter/pressrelease/global_pressrelaease.asp?seq=19970106_0000000462).

computer monitors and TVs.<sup>7</sup> Table 2 shows the quarterly worldwide unit sales of LCDs 12 inch and greater in diagonal size used for notebook computers, for computer monitors, for TVs, and for other uses.<sup>8</sup>

9. Prior to the increased popularity of LCD displays, CRTs were the dominant display technology. Around the same time that sales of LCDs were increasing, plasma display panels were also becoming more popular. During much of the relevant period, plasma panels could be made much larger than LCD or CRT displays.<sup>9</sup> However, due to the greater power consumption and greater weight of CRTs, LCDs have dominated in the 12 inch to 30 inch sizes relevant to this case. Table 3 shows the unit sales of CRTs, LCDs, and plasma displays over the period 2001 through 2009. By the end of 2009, LCDs had about 90% of unit sales.<sup>10</sup>
10. LCDs can vary in a number of ways, including size, resolution, contrast, bit depth, and response time.<sup>11</sup> Resolution refers to the number of pixels on a given display. Contrast refers to the ratio of the brightest white to the darkest black. Bit depth concerns the number of colors that can be produced by the display. Response time refers to how quickly a liquid crystal alters shape (twists) to block or pass light.<sup>12</sup>

<sup>7</sup> Some of the Crystal Meeting Participants are vertically integrated into the finished products. For example, Samsung makes and sells its own branded TVs. AUO, CMO, CPT and HannStar have affiliates that make monitors and TVs. LG's parent LG Electronics makes monitors and TVs.

<sup>8</sup> During the conspiracy period, "other panels" account for a low of 2.1% of the total units in Q4/01 to a high of 4.2% in Q1/06.

<sup>9</sup> Plasma has advantages over LCDs including superior contrast, wide viewing angles, and less motion blur. They also have disadvantages including screen burn-in, loss of luminosity over time, greater weight and depth, and greater power consumption.

<sup>10</sup> Plasma TVs are not available in the 12-30 inch sizes.

<sup>11</sup> LCDs are produced on large sheets of glass with the size depending on the plant. The industry refers to the plants by "generation." Newer generation plants (the oldest plants are "gen 1" plants) accommodate larger sheets, making it possible to produce a larger size LCD. In addition, later generation plants can produce more of a given size LCD, as the finished sheets are cut into the desired set of sizes. According to a widely used outside supplier of information concerning the LCD industry (discussed further below), DisplaySearch, the LCD producers can simply and easily alter the sizes cut from a given glass sheet ("It doesn't matter how you slice it. Pizza is pizza; area is area." *TFT LCD Business Cycles and Trends*, 21 Sep 05, p. 13.)

<sup>12</sup> LCDs can also vary by brightness, thinness, connections, and mounting holes. These characteristics can be readily changed by manufacturers.

11. As mentioned above, large LCDs are typically made in newer generation fabrication plants that can accommodate larger glass sheets allowing for more efficient cutting of larger panels.<sup>13</sup> In addition, I understand that the more dense pixel arrays of smaller size LCDs are most efficiently accomplished with a technologically distinct process such that some specialization by intended output size is expected and achieved.
12. LCD fabs started making larger size LCD panels (over 30 inch) for large screen TVs beginning in early 2003 with the 32 inch size. About six months later, 40 inch models became available, with 52 inch panels being offered by mid-2006.<sup>14</sup> However, during the period October 2001 – June 2006, large screen TVs accounted for only about 2.5% of LCD panels sold.<sup>15</sup>
13. Large screen TVs entered the market with small production volume and at relatively high prices. On entry, the pricing of the large screen TVs is significantly different than for the commodity like 12-30 inch LCD panels.<sup>16</sup> This is shown in Chart 1. As evident from these Charts, there is a much greater decline in the prices of these large screen TVs over time and the prices do not exhibit the degree of cyclical behavior as the more commodity like panels in the 12-30 inch size.
14. LCD panels are sold to many buyers and are also “sold” by some of the vertically integrated manufacturers to themselves to make notebooks, monitors and TVs. During the period October 2001 through June 2006, about 410 million LCD panels were sold by the Crystal

<sup>13</sup> This is seen in Table 4 below which shows the greater production of larger panels from the newer plants. According to DisplaySearch “Gen 6 was designed for 32”/37”, Gen 7 for 40”/42”, and Gen 8 for 46”/47”/52-57”.” CPT02317347ppt.pdf, Quarterly Large Area TFT LCD Product Plan Report Q1’07, 3/2/07, p. 47.

<sup>14</sup> I count a panel size as being “available” when at least 500 units are sold in a month.

<sup>15</sup> In Q2/06, large TVs accounted for 7.9% of LCD panels sold. The Crystal Meeting Participants had a disproportionate share of panels 12 – 30 inches compared with below 12 and above 30.

<sup>16</sup> According to Sharp, “the Korean Defendants, and later the Taiwanese Defendants, capitalized on their lower costs of production to produce cheaper commodity-sized panels.” Sharp’s Motion for Partial Summary Judgment that the Japanese Defendants Did Not Participate in the Crystal Conspiracy, p. 1, emphasis added. See also Table 10 below and accompanying text.

Meeting Participants. These panels were sold to over 1,600 different buyers. The largest buyer was Dell which bought 11.7% of the panels.<sup>17</sup> The second largest buyer, LG Electronics, an LG affiliated company, bought 8.5% of the total panels sold. No buyer of LCD large panels was of sufficient importance that the buyer would have enough buyer market power to make an attempt at collusive pricing ineffective.

15. The possibility of consumers switching to non-LCD products in response to supra-competitive pricing of LCD panels did not prevent the LCD manufacturers from setting above competitive prices. For notebook displays, this is obvious because there were no alternatives to LCD panels. For computer monitors and TVs, CRT displays were once the dominant technology. However, the rapidly declining prices of LCD monitors and LCD TVs (due to economies of scale and the efficiencies of newer fabs), and the greater energy efficiency, longer life, and small footprints of LCDs have resulted in dominance of the LCDs.<sup>18</sup> While CRTs, a technology that was becoming obsolete, may have been somewhat of a competitive factor early in the Crystal Meeting time period,<sup>19</sup> beginning at least at the time of the Crystal Meetings, control over the price of LCD monitors and TVs would allow above competitive pricing.

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<sup>17</sup> Dell was the subject of additional bilateral conspiracies. See, e.g., Plea Agreement, U.S. v. Hitachi ("From on or about April 1, 2001 to on or about March 31, 2004, the defendant ... participated in a conspiracy with other major TFT-LCD producers ... to fix the price of TFT-LCD sold to Dell ..." ¶4.(c)); U.S. v. Sharp Corporation ("From on or about April 1, 2001 to on or about March 31, 2004, the defendant ... participated in a conspiracy with other major TFT-LCD producers ... to fix the price of TFT-LCD sold to Dell ..." ¶4.(c)).

<sup>18</sup> DisplaySearch has presented data showing that the energy savings and space saving of LCDs make them lower cost overall, even at supra-competitive pricing, than CRTs (CPT00840772-73, CPT00956018-19). Sharp 30(b)(6) witness Yokota Masahiro testified that Sharp did not consider the pricing of CRT televisions in its pricing of LCD TVs (Dep. pp. 153-154). Toshiba 30(b)(6) witness Michael Blashe testified that Toshiba does not consider the costs of CRT technology in setting its LCD display prices (Dep. pp. 148-49). In addition, as discussed further below, the relationship of short run average variable cost to long run average total cost in LCD manufacturing can lead to competitive LCD prices far below the entry LCD price at which CRTs might be competitive with LCDs.

<sup>19</sup> See, e.g., GRN000073-78.



16. A given LCD fabrication plant can readily alter the size of the particular type of 12-30 inch LCD panels it produces,<sup>20</sup> and it can do so within a relatively short planning time.<sup>21</sup> The ability to substitute in production is seen in Table 4 which shows the different size panels made on individual LG fabrication lines. Production substitution is shown by, for example, fab P2 making 6 different panel sizes in June 2002 and June 2003 (and two of the six were different panels); fab P5 making 7 different panel sizes in June 2005; and fab P6 switching from 42 inch panels to 26 inch panels from June 2005 to June 2006. Such production substitution opportunity implies a high cross elasticity of supply among 12-30 inch LCD panels.<sup>22</sup> Thus, an effective conspiracy to raise LCD panel prices above competitive levels is expected to extend to all significant panels in the 12 to 30 inch size range.
17. As shown in Table 1 above, over the 2002-2010 period, the costs of an efficient (at the time of construction) LCD fab ranged from \$1.3 billion (2002 gen 5) to \$4.6 billion (2010 gen 10). This is obviously a very large cost that must be incurred to participate in the LCD business. Most of this cost is for facilities and equipment that are specialized to LCD production. The economic importance of this fact is that an entrant into the LCD industry can recover the capital investment entry cost only through the production and sale of LCDs. As a result, even if LCD prices are above long run average costs including the capital costs, firms will still have some reluctance to enter the industry. This is because an entrant will be

<sup>20</sup> See, e.g., Lu dep. pp. 83-84, Ko dep. p. 74-75, and the DisplaySearch "pizza is pizza" quote in footnote 11 above. For smaller panels that do not require dense pixels, such substitution across sizes is also relatively simple. However, for dense pixel small panels such substitution would require significant manufacturing changes. Large panels for TVs over 30 inches can be efficiently made only at newer generation fabs.

<sup>21</sup> See, e.g., Lin, Chen and Lin, "A Hierarchical Planning and Scheduling Framework for TFT-LCD Production Chain," *2006 IEEE International Conference on Service Operations and Logistics, and Informatics*, 2006. Lin, Chen and Lin note that "It takes 12 to 19 days to go through all the three (the array, cell and module are the three primary manufacturing processes for TFT-LCD) process sequentially ..." p. 712.

<sup>22</sup> Cross elasticity of supply refers to the percentage change in supply of one product in response to a given percentage change in the price of another. A high cross elasticity of supply means that there will be a large change in supply of one product when the price of another changes by a small amount. In the context of this case, a change in the price of one size panel holding constant the price of another size will cause the manufacturers to cut more of the relatively higher priced size and less of the relatively lower priced sizes implying a high cross elasticity.

concerned not about current prices (prices at the time of the entry decision) but rather about prices after its entry (some 2-3 years after the entry decision is made when the plant will be finished and operating.) With the approximately three year minimum lead time for plant construction and ramp up, this upfront sunk cost of entry presents substantial uncertainty about the economics of entry.<sup>23</sup> This is particularly so if the supra-competitive prices that might motivate entry result from a conspiracy (rather than a supply shortage). In the case of a conspiracy, the entry of a new firm can upset the conspiracy leading to price reductions that may not allow recovery of the new entrant's capital cost. Thus, in the context of this case, the very large sunk cost required to enter the LCD industry acts as a significant barrier to entry.<sup>24</sup> This barrier to entry is recognized in the industry.<sup>25</sup>

18. The specifications of the features of LCDs are standardized. Resolution has generally improved over time, with common resolutions for monitors, notebooks, and TVs including VGA (video graphics array 640x480 pixels), XGA (extended graphics array 1024x768), WXGA (wide XGA 1280x768), SXGA (Super XGA 1280x1024), and WUXGA (widescreen ultra XGA 1920x1200). Contrast is typically offered in 300:1 and 600:1 alternatives for monitors, and 800:1 and 1200:1 for TVs. Bit depth is available in 6, 8 or 10 bits per pixel. Response times are measured in milliseconds. The quality of an LCD is also affected by the presence of defective or dead pixels. The International Organization for Standardization

<sup>23</sup> Regarding the lead time and ramp up, see, e.g., AU Optronics Form 20-F 2006. See also Kunimoto dep. p. 45.

<sup>24</sup> See McAfee, Mialon, and Williams, "What is a Barrier to Entry?" *American Economic Review* 2004. While the very substantial sunk investment to enter the LCD market is sufficient for me to conclude that there are high barriers to entry, patents and intellectual capital also impede entry. See, e.g., GRNE-B-0132293 and the many patent suits in the industry. Consistent with such barriers, as implied in Chart 2 below, there has been very little actual entry in the last decade in this rapidly growing market.

<sup>25</sup> See, e.g., Initial Public Offering – LG Philips LCD Co., LTD, EDGAR Online, <http://ipportal.edgar-online.com/ipo/textSection.ASP?cikid=640909&fnid=40145&IPO=1&sec+cm&coname=LG.PHILIPS+LCD+CO.%2C+LTD>; GRNE-B-0132293 slide 61; GRNE0078761, 86; Yeung, "From Followers to Market Leaders" Asian Electronics Firms in the Global Economy. Asia Pacific Viewpoint, 2007 ([http://courses.nus.edu.sg/course/geoywc/publication/2007%20APV\\_Yeung.pdf](http://courses.nus.edu.sg/course/geoywc/publication/2007%20APV_Yeung.pdf)).

(ISO) issued an LCD standard (ISO 13406-2) in 2001. This standard defines Pixel Fault Classes with maximum numbers of pixel faults. Two other standards groups, Video Electronic Standards Association (VESA) and Standard Panels Working Group (SPWG), also publish industry standards.

19. The economic significance of the standardization of the various “quality” measures is that an LCD panel of a given resolution, contrast, bit depth, response time and pixel fault class is relatively homogeneous regardless of the manufacturer.<sup>26</sup> The relatively homogeneous nature of an LCD of given specification is demonstrated by purchasers substituting among manufacturers.<sup>27</sup> Buyers seeking a particular specification of a LCD can readily obtain such supply from multiple manufacturers.<sup>28</sup> Table 5A summarizes the number of LCDs of the same specifications that are offered by 3 or more of the Crystal Meeting Participants. As shown in the Table, 75% or more of the total panels 12 inches and above were available from three or more of the Crystal Meeting Participants during the conspiracy period. Table 5B shows the availability of alternative suppliers from the buyers’ perspective. For Dell and for HP, over 69% of the panels 12 to 30 inches which they purchased were available from multiple suppliers.

20. As discussed above, there is a substantial sunk cost to construct an efficient LCD fab. Documents from the Crystal Meeting Participants show that the “fixed” cost of LCD production is about 24% of the total cost of production.<sup>29</sup> In addition to the implications as to barriers to entry, the high fixed and sunk cost implies the potential for substantial losses with

<sup>26</sup> An employee of CPT, Fu-Chia Tai, filed a declaration in which he testified as to how conformity with industry standards leads to customers viewing panels of one manufacturer as being interchangeable with those of other manufacturers. Declaration of Fu-Chia Tai pp. 2-3.

<sup>27</sup> HITDOJCIV00508845, Birnbaum (Samsung) dep. p. 305, Pan (AUO) dep. pp. 130-31.

<sup>28</sup> The “flip-side” of this is also evidence of the substitution possibilities among manufacturers. According to the Tai Declaration op cit., 85-90% of the LCDs sold by CPT were standardized panels or panels with some customer features that did not affect the price.

<sup>29</sup> From LG fixed and variable costs data.

competitive pricing in the LCD industry. In the long run, no LCD manufacturer will remain in the industry unless prices are such that it is able to recoup both its variable costs and its capital costs of production. However, with fabrication plants in place (the shorter run), a manufacturer will remain in business as long as the prices allow it to recoup its variable costs of production. Given the two to three year plus lead time for a new fab, a potential entrant into LCD manufacturing needs to be very diligent in assessing future demand and future industry capacity. If, on entry, capacity exceeds demand, it is likely that prices can fall to the level of variable cost with large long run losses implied.

21. Chart 2 shows the capacity shares for the Crystal Meeting Participants by company for Q1/2002, Q1/2004, Q1/2006, and Q1/2008. Chart 3 shows the combined capacity shares of the Crystal Meeting Participants by quarter Q4/01- 2009 for all panels, while Chart 4 shows the unit sales shares for panels greater than 12 inches. During the conspiracy period, the Crystal Meeting Participants controlled from 61% to 79% of unit sales of all LCD panels greater than 12 inches.<sup>30</sup> Thus, the large panel LCD industry, panels greater than 12 inches, is relatively concentrated. Economic analysis of “dominant firms” demonstrates that very significant anticompetitive impacts can result when a seller (or set of cooperating sellers) controls about 60 percent or more of an industry.<sup>31</sup> I have therefore reached the opinion that the Crystal Meeting Participants had sufficient market presence to set above competitive prices for large panel LCDs.

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<sup>30</sup> This underestimates the market share of the Crystal Meeting Participants for panels 12-30 inches. However, given the relatively small percentage of the market accounted for by panels larger than 30 inches, the difference between the share of 12 plus and 12-30 inches will be small.

<sup>31</sup> See e.g., George J. Stigler, October 1965, The Dominant Firm and the Inverted Umbrella, *Journal of Law and Economics*, Vol. 8, pp. 167-172; Dennis W. Carlton and Jeffrey M. Perloff, 2004, *Modern Industrial Organization: Fourth Edition*, Prentice-Hall, pp. 111-116; John S. McGee, 1988, *Industrial Organization: First Edition*, Prentice-Hall.

22. As implied by the Crystal Meeting Participants' market share of less than 100%, the Crystal Meeting Crystal Meeting Participants did not include all LCD producers. Most importantly, the Japanese producers Sharp, Hitachi, Epson-Sanyo, Toshiba, Fujitsu, NEC and Sony did not participate in these meetings. But as a group, these Japanese producers (together with any other non-participants) accounted for only a small share of the market. In addition, the market concentration statistics presented above understate the ability of the Crystal Meeting Participants to control large panel LCD prices due to a significant degree of business relationships and communications among these Crystal Meeting participants and many of the Japanese manufacturers of LCDs.<sup>32</sup> In addition, the Japanese companies were involved in price fixing conspiracies with some of the Crystal Meeting participants regarding the pricing of LCDs to particular customers. The Japanese companies also tended to specialize in specialty niche products, smaller dense pixel panels, and in the large screen TVs.<sup>33</sup>

<sup>32</sup> AUO has a stake in Fujitsu Display Technologies and a collaboration agreement on R&D. (AU Optronics, 1/28/03, AU Optronics and Fujitsu to Announce Extensive Collaboration in LCDs, <http://auo.com/auoDEV/pressroom.php?sec=newsReleases&intTempId=1&intNewsId=93&ls=en>); Samsung and Sony had an LCD joint venture. (Sony, 4/19/05, AE-LCD-EL02203, <http://www.Sony.net/SonyInfo/News/Press/200504/05-0419e/index>); Hitachi sold LCDs to Samsung (Kobayashi dep. pp. 43-44 Hitachi 30(b)(6) witness); NEC bought LCDs from CMO (NEC, 4/26/01, NEC and Chi Mei Optoelectronics Agree to Collaborate in the Area of TFT LCD, <http://www.NEC.co.jp/press/en/0104/2602.html>); Sharp bought LCDs from AUO, CMO, and Samsung (Yokota dep. pp. 109-10, Morimitsu dep. pp. 131, 152). The Korean and Taiwanese manufacturers also have extensive intellectual property cross licenses with the Japanese manufacturers. These include the following pairs: LG-Hitachi, LG-NEC, AUO-Hitachi, AUO-Samsung, AUO-Sharp, CMO-Fujitsu, CMO-Sharp, CPT-Sharp, CPT-Hitachi, CPT-Mitsubishi, HannStar-Hitachi, HannStar-Sharp. See, e.g., DisplaySearch, For Asia Round Table Forum, Taipei, May 20, 2005 p.12 (showing investment and cross licensing in the LCD industry). Yin-Hua Hsu of CPT described group meetings and communications that included Hitachi, Sharp, and Mitsui Busan (the Taiwanese agent for Epson) in addition to the Defendants. See Declaration of Yin Hua (Asuka) Hsu ¶¶2, 3, 6. The communications concerned shipment and pricing information (¶5).

<sup>33</sup> According to Stanley Park of LG "it doesn't matter whether the Japanese join the meeting or not." Dep. 9/17/09 p. 90. C.C. Liu of CPT [Japanese not needed at Crystal Meetings because] "Japanese vendors no longer are important in the market." Dep. 4/30/10 p. 39. According to Sharp Corporation, "the Japanese Defendants [in the indirect purchasers class cases] were exiting the market segments ... that were the focus of the Crystal Meetings. ... the Japanese Defendants were relegated to more specialized panels of smaller and larger sizes." Sharp's Motion for Partial Summary Judgment that the Japanese Defendants Did Not Participate in the Crystal Conspiracy, p. 1. That these Japanese producers focus on more dense pixel small panels is evident in the Expert Report of Professor Janusz A. Ordovery Regarding Class Certification at Exhibits 9a-9c which show a very large market share for "non-defendants," Sharp and Toshiba for mobile phone panels (9a), but quite low market shares for notebooks and monitors (9b and 9c).

## The Conspiracy

23. Beginning as early as 1998, various LCD producers had meetings at which the pricing of LCDs was discussed. These early meetings included meetings between LG and Hitachi,<sup>34</sup> Samsung and Sharp,<sup>35</sup> and CPT and Matsushita,<sup>36</sup> These meetings typically concerned the pricing to specific customers.<sup>37</sup>
24. Beginning in late 2001, the Crystal Meeting Participants began regular monthly meetings, known as the Crystal Meetings, at which the participants discussed LCD pricing. Table 6 summarizes these meetings, including the dates and the participants. All of the corporate participants at these meetings except AUO, including CMO, CPT, HannStar, LG, and Samsung, have pled guilty or acknowledged participation “in a conspiracy to suppress and eliminate competition by fixing the prices of thin-film transistor liquid crystal display panels sold in the United States and elsewhere ....”<sup>38</sup>
25. Extensive notes were taken at these meetings by the participants. I have carefully reviewed these notes. The notes indicate that specific prices of specific products were discussed.<sup>39</sup>
- These are meetings at which it is most likely that supra-competitive prices will result. Table

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<sup>34</sup> GRNE-B-0133233.

<sup>35</sup> SAML-276862’

<sup>36</sup> CPT0230802201e.

<sup>37</sup> See, e.g., Plea Agreement, U.S. v. Hitachi (“From on or about April 1, 2001 to on or about March 31, 2004, the defendant ... participated in a conspiracy with other major TFT-LCD producers ... to fix the price of TFT-LCD sold to Dell ...” ¶4.(c)); U.S. v. Sharp Corporation (“From on or about April 1, 2001 to on or about March 31, 2004, the defendant ... participated in a conspiracy with other major TFT-LCD producers ... to fix the price of TFT-LCD sold to Dell ...” ¶4.(c)); U.S. v. Epson Imaging Devices Corporation (“During the relevant period (the fall of 2005 to the middle of 2006) the defendant ... participated in a conspiracy with other major TFT-LCD producers ... to fix the price of TFT-LCD sold to Motorola ... ¶4.(c)). These bilateral agreements also included Apple. See Sharp’s Motion for Partial Summary Judgment that the Japanese Defendants Did Not Participate in the Crystal Conspiracy, p. 2.

<sup>38</sup> Plea Agreement, U.S. v. Chi Mei Optoelectronics Corporation, ¶2.

<sup>39</sup> An early meeting defined the general dimensions of the agreement – “principle of pricing ... the list prices are net selling prices (net prices). Each maker may adjust according to the respective situation, but the prices cannot be lower than these prices.” CPT0004008-11. Supply and demand conditions were generally discussed at the meetings. Production levels and expansion plans were also discussed. However, other than the deposition testimony of C.C. Liu (dep. 4/30/10 p. 128-29), I have not reviewed evidence of explicit agreements to allocate production or limit expansion.



6 shows the meetings at which specific prices were discussed,<sup>40</sup> I refer to these meetings as Price Meetings. Table 6 also shows the conspiracy meetings at which the notes do not evidence the discussion of prices of specific products. I refer to these as Conspiracy Meetings. These include the meetings in September and October 2002, the meeting of November 2004, and the meeting in February 2005. In addition, specific price discussions are longer contained in the meetings notes after January 2006.<sup>41</sup>

26. In the meeting notes, participants have acknowledged that their price discussions were successful in increasing prices.<sup>42</sup> As described below, using transactions level data, I have confirmed the close relationship between the actual prices and the Crystal Meeting prices for the products discussed during the Price Meeting months.<sup>43</sup> Transactions level data was received from AUO, CMO, CPT, HannStar, and LG pursuant to a Grand Jury Subpoena. Data production from Samsung was obtained pursuant to an amnesty agreement. Data from CMO, CPT, HannStar, LG, and Samsung covered the entire period of my empirical work, October 2001 to December 2009. Invoice data from AUO ended in December 2008.<sup>44</sup> Invoice data from the six Crystal Meetings Participants were used as the source of panel

<sup>40</sup> The attached electronic file crystal\_prices\_products.xlsx summarizes the details of the specific price discussions including the products and the prices or prices ranges discussed.

<sup>41</sup> See June 7, 2011 letter from Michael Scott U.S. DOJ to James McGinnis, Re: Samsung Electronics Company Ltd, "On July 13, 2006 LG Display approached the government to report its participation in anticompetitive conduct in the TFT-LCD industry." See March 3, 2011 letter from Michael Scott U.S. DOJ to James McGinnis, Re: LG Display Co., Ltd.

<sup>42</sup> See, e.g., CPT0004015.01e-.02e, CPT0004020.02e, CPT0004020, GRN000010, CPT0004015.01E-02E, CPT0004015.02E, CPT0004028.01E, CPT0004042.02E, CPT0004042.01E, CPT0004050E.

<sup>43</sup> By Crystal Meeting prices I refer to prices of specific products as discussed in the Crystal Meeting notes.

<sup>44</sup> AUO invoice data from July 2008 to December 2008 were not used. AUO's invoice data for July 2008 contained only about half as many unit sales as were reported in AUO's public financials and AUO's average monthly panel prices were between \$23 and \$82 between August 2008 and December 2008. HannStar invoice data between September 2008 and December 2008 was also not used as the average monthly panel prices were between \$17 and \$-66 for this period.

(diagonal) screen size, application (use), and resolution for each invoice entry.<sup>45</sup> Data production from LCD panel customers was also obtained from voluntary production.

27. Using the invoice data, I first examine the average monthly actual AUO prices and the average Crystal Meeting Participants' prices of panels of a given size and use as compared to the level of the Crystal Meeting prices for those panels.<sup>46</sup> Charts 5A-5E summarize this examination for the five most popular panel sizes. It is clear from these Charts that there is a very close relationship between the actual prices and the Crystal Meeting prices for both AUO and for the Crystal Meeting Participants as a group. Chart 5F collects the data on all the Crystal Meeting Participants and all the panels for which there were price discussions. I have statistically confirmed this close relationship by calculating the correlation coefficient between the levels and the changes in the levels of the Crystal Meeting prices and the levels and the changes of the actual prices in the month of price discussions. The results are summarized in Table 7. The correlations of the price levels for the Crystal Meeting Participants as a group range from .979 to .991, from .944 to .989 for AUO. These are highly statistically significant showing a near perfect match. The correlations of the changes in the prices are also all positive and statistically significant at over the 99% level.
28. Charts 5A-5E also suggest that AUO's pricing is generally comparable to that of the other Crystal Meeting Participants. This is confirmed in Charts 6A-6E which show the AUO average monthly prices along with the average monthly prices of each of the other Crystal Meeting Participants for the top five selling products. Of all the month-product price

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<sup>45</sup> When screen size, application, or resolution were not available in the invoice data as separate fields, this information was extracted from the model code listed in the invoice based on model part decoder documents or from information provided from the LCD panel producer.

<sup>46</sup> The Crystal Meeting price for a month is the price discussed at that month's Crystal Meeting. If the Meeting also discussed a price for the next month, that price is also a Crystal Meeting price for that month. If the following month discussed a different price from the price for that month discussed in the prior month, the average of these two prices is used.



observations, the AUO price was higher than the average of the other Crystal Meeting Participants' price 48.9% of the time. This indicates that AUO was not simply "competing" against others' Crystal Meeting prices.

29. The price analyses of Tables 5A-5E are based on the average AUO and Crystal Meeting Participants' monthly prices of all LCD panels of a given size and use. As discussed above, LCD panels can vary in ways other than size and use. I have also examined the extent to which the prices of panels of given size and use but differing in other specifications such as resolution, contrast, or viewing angle might vary in price from Crystal Meeting prices. Charts 7A-7C summarize the monthly dispersions of AUO's prices of some of the panels discussed at the Crystal Meetings for the Price Meeting periods. The darker blue shaded area shows the range in which 50% of the transactions occur. These data are based on transactions counts and not units.<sup>47</sup> The unimportance of the outlier prices is bolstered by the fact that about 85% of the panels in Charts 7A – 7C are within 15% of the average price.
30. The data in Charts 5 and 6 include prices paid by many different buyers. Charts 8A-8E examine separately the prices paid by major buyers for the panels with prices discussed at the Crystal Meetings. These charts show the average prices paid by each of the top five leading purchasers (excluding buyers affiliated with the Crystal Meeting Participants) of the most significant panels sold during the conspiracy period, the Crystal Meeting prices and the average prices for all buyers. A very close fit is seen, showing that buyers generally paid the Crystal Meeting prices. Charts 9A-9E show the monthly changes in the prices charged to each of the five leading buyers of the major panels, the changes in the Crystal Meeting prices, and the changes in the average prices. Again, a very close relationship is seen.

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<sup>47</sup> The prices that are most at variance with the mean are likely "unusual" prices associated with few unit sales.

31. From the analysis summarized above, I have reached the opinion that the discussions of prices by the Crystal Meeting Participants were effective in that the Crystal Meeting prices were generally implemented and charged to the buyers.
32. During the conspiracy period, many different size, resolution and use large panel LCDs were produced. Not every LCD panel type was subject to specific Crystal Meeting price discussions. However, the panels subject to specific price discussions account for a disproportionate amount of sales. This is shown in Table 8 for AUO and in Table 9 for the Crystal Meeting Participants as a group. At the beginning of the conspiracy, the fourth quarter of 2001, the panels that were subject to price discussions accounted for nearly 98% of the total unit sales for AUO's unit sales of LCD panels greater than 12 inches, and nearly 85% for the Crystal Meeting Participants as a group.<sup>48</sup>
33. The panels subject to the price discussions were also the more commodity type panels that would be subject to the greatest competitive pressures. This is shown in Table 10 which calculates the percentage of panels with Crystal Meeting price discussions that were sold by various numbers of the Crystal Meeting Participants compared to other panels. 84.6% of the panels subject to price discussions were sold by five or six Crystal Meeting Participants in the Price Meeting months while only 6.2% of the other panels were sold by five or six of the Crystal Meeting Participants in those months.
34. In addition to having discussions about specific prices of specific panels, the notes from the Crystal Meetings indicate that the participants frequently discussed general pricing relationships among LCD panels of different specifications.<sup>49</sup> This suggests that discussions

<sup>48</sup> According to Stanley Park "most of the mainstream sizes" of both notebook and monitor panels were discussed at the Crystal Meetings. Dep. 9/17/09 p. 86-88. C.C. Liu of CPT confirmed that the Crystal Meeting participants "talk about the main size, main type in the meeting." Dep. p. 94.

<sup>49</sup> See, e.g., CPT0004035, GRN000027, CPT0004041.02E, GRN000031-41, GRN000132, GRN000045.

of the particular prices of “bellwether” panels will likely impact other panels for which there were no specific discussions.<sup>50</sup> I have verified this expectation through an examination of the prices of other major LCD products that were not specifically discussed at the Crystal Meetings.

35. Charts 10A-10C show the prices of the panels with Crystal Meeting price discussions (shown in red) and other major panels (not red) of comparable size. To ease the comparison, all prices are standardized to equal 1 in January of 2004. The charts show a close fit between the price movements of the panels with price discussions on panels and other panels.
36. Table 6 above summarized the Crystal Meetings at which specific price discussions were reached (Price Meetings) and Meetings at which discussions of specific prices were not noted in the meeting notes (Conspiracy Meetings). These Conspiracy Meetings periods are September - October 2002, November 2004, February 2005, and February through June 2006. In Chart 11, I plot the AUO prices of the most common panel produced during the conspiracy period, the 17” SXGA monitor with the Price Meetings and the Conspiracy Meetings periods highlighted. It is clear in Chart 11 that the Conspiracy Meetings occurred during periods where the actual and Crystal Meeting prices are in decline at the trough of price cycles. As was noted above, the Crystal Meeting notes include discussions of the need to limit output to sustain the collusive prices, but neither output quotas nor customer allocations were achieved. In such a conspiracy, it is expected that collusive increases in prices and the resulting reductions in quantities demanded will put “inventory” pressure on prices. In the Price Meetings months just preceding a non-Price Meeting Conspiracy

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<sup>50</sup> According to Sam Wu of HannStar “They had discussions about what would be a reasonable price for the market for 14 or 15”. Then, there would be a price difference for panels of other sizes. Sometimes they compared prices for different products at the meetings. The competitors proposed that the 15” NB price should equal the 14.1 panel + \$45. The decisions were then made about the correlation between different products.” Sam Wu Interview Notes p. 14.

Meeting, the average difference between the AUO actual price and the Crystal Meeting price is more than double the average difference in other Price Meeting months.<sup>51</sup> The downward trend of prices and the increasing gap between the Crystal Meeting prices and the actual prices that precedes the Conspiracy Meetings periods are consistent with increasing pressure on prices leading to the absence of specific price discussions at those Conspiracy Meetings.

37. The Crystal Meetings continued through at least June 2006. However, in late January 2006, Samsung approached the Department of Justice seeking acceptance in the Antitrust Division's Amnesty Program, and in April 2006, Samsung formalized an agreement with the Department in which it agreed to terminate its participation in the conspiracy.<sup>52</sup> In July of 2006, LG also self reported to the Department of Justice the existence of the price fixing conspiracy and its participation.<sup>53</sup> It is also of significance that the percentage of panels subject to price discussions had fallen significantly by the end of the Price Meetings period (January 2006).<sup>54</sup>

### **Quantification of the Overcharge from the Conspiracy**

38. The economic incentive to engage in price fixing conspiracies arises from the attempt to raise profits through prices above competitive levels (the levels that would exist absent the price fix). As a first and simplistic indication of the success of the Crystal Meeting conspiracy, I examine the margins earned in the LCD industry over time. The monthly margins are shown in Chart 12. The Price Meeting periods, the Conspiracy Meeting periods, and the post-

<sup>51</sup> The average difference between the AUO actual average monthly price and the Crystal Meeting price is 2.2%, and in the months preceding the Conspiracy Meetings (August 2002, October 2004, and January 2005) the difference average 5.3%.

<sup>52</sup> See April 3, 2006 DOJ letter to Gary Halling and June 7, 2011 letter from Michael Scott U.S. DOJ to James McGinnis, Re: Samsung Electronics Company Ltd.

<sup>53</sup> See LG Displays Reply in Support of Its Motion for Partial Summary Judgment on Withdrawal, August 12, 2011 and March 3, 2011 letter from Michael Scott U.S. DOJ to James McGinnis, Re: LG Display CO., Ltd.

<sup>54</sup> This is shown in Table 9.

conspiracy period are also shown in Chart 12. The average margins earned for each of these periods are summarized in Table 11. Consistent with an effective conspiracy, the margins during the Price Meeting periods averaged over 300% greater than the post-conspiracy period (\$942 versus \$229), while the margins during the Conspiracy Meeting periods average 109% greater than the post-conspiracy period (\$478 versus \$229).

39. A simple comparison of margins does not control for any other supply or demand variables that might impact margins. A more sophisticated analysis that takes account of important supply and demand variables can control for the effects of these variables. In order to quantify the price impact, if any, of the Crystal Meeting conspiracy, I construct and estimate a structural model of the LCD industry. Such an approach is standard both in the economics literature, and in the calculation of overcharges in antitrust cases.<sup>55</sup>

40. The structural model begins with the demand and supply equations:

$$E1. \text{ Quantity Demanded} = f(\text{demand variables, price})$$

$$E2.1. \text{ Quantity Supplied} = g(\text{supply variables, price, competitive conditions})$$

$$E2.2. \text{ Price} = h(\text{supply variables, QSupplied, competitive conditions})$$

The equilibrium condition is given by:

$$E3. \text{ Quantity Demanded} = \text{Quantity Supplied.}$$

<sup>55</sup> Such an approach is standard in the economics literature. See, e.g., Davidson and MacKinnon, *Estimation and Inference in Econometrics*, Oxford (1993), Chapter 18; Hausman, "Specification and Estimation of Simultaneous Equation Models," Ch. 7 in *Handbook of Econometrics*, Vol. 1, eds. Z. Griliches and M. Intriligator, North Holland (1983); Goldberger, *A Course in Econometrics*, Harvard (1991), Chapters 30-34; and Ruud, *An Introduction to Classical Econometric Theory*, Oxford (2000), Chapter 26.

The use of structural modeling in a cartel context is also an accepted and standard approach to estimating overcharges. See, e.g., Brander and Ross, "Estimating Damages from Price-Fixing," *Canadian Class Action Review*, 3 (2006) p. 335-369; Finkelstein and Levenbach, "Regression Estimates of Damages in Price-Fixing Cases," *Law and Contemporary Problems*, 46 (1983), p. 145-169; Porter "A Study of Cartel Stability: The Joint Executive Committee, 1880-1886," *Bell Journal of Economics* 14 (1983), p. 301-314.

The discussion of the use of regression analysis in damages estimation has been discussed in 267 F.R.D. 291 (In re TFT-LCD Flat Panel Antitrust Litigation) by Judge Illston - "...courts have accepted multiple regression and correlation analyses as means of proving antitrust injury and damages on a class-wide basis." p. 313.

The competitive conditions variable refers to the changes in the competitive relationships in the LCD industry because of the Crystal Meetings. This is the variable of interest in quantifying any effect of the conspiracy on prices paid for LCDs.

41. Implementation of the model requires construction of a proper price variable, specification of the demand and supply variables, and the competitive conditions variable, and examination of the econometric features of the resulting implicit structural equation (E2.2.) to guide the correct estimating procedure. I will discuss each in turn.
42. As noted above, there are many different “models” of 12 to 30 inch LCD panels and these panels can vary by size, resolution, use, and other specifications. However, the analysis of the prices of products subject to specific price discussions and the other products suggests that the conspiracy impacted all relevant LCD panels. Therefore, I seek a single price variable that captures the “industry price” of 12 to 30 inch LCD panels.
43. In order to directly compare the prices of panels of different size, I have constructed such a single price metric – the areal price – that measures the average industry price of LCD panels. The areal price of a panel is the price per square meter. As discussed above, LCD panels are cut from larger glass sheets. While there is a border of “waste” associated with each cut panel, the per square meter cost of converting the glass sheets to an LCD sheet should be approximately related to the size of the cut panel. This suggests that the cost of producing panels of different sizes from a given fab will be approximately linear with respect to the total area of the panel, as therefore would also be the competitive prices. The approximate linearity of costs with area has been confirmed in published research.<sup>56</sup>

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<sup>56</sup> Pye, “Yield Mangement in LCD Fabs,” *Information Display*, 11/2005. See LCD cost graphed against area on p. 27. Pye also runs a simple regression in which area explains 99% of the variation in costs.

44. I have also confirmed the approximate linearity of prices with panel size. Charts 13A-13C shows the average industry price for panels of different sizes in January 2002, 2004, and 2006, respectively, plotted against the panel size. Again an approximate linear relationship is apparent. This was statistically confirmed by regressing the average prices of different panels against the panel size. A strongly statistically significant linear relationship was found.<sup>57</sup>
45. The legitimacy of areal cost and areal price variables is also confirmed by the wide use of such variables in the industry. DisplaySearch, the leading purveyor of data, market research and LCD industry information,<sup>58</sup> reports numerous statistics on a per-square-meter basis.<sup>59</sup> DisplaySearch explains how “Cost Follows Display Area,” and “Areal Prices Converge,” noting that “over the mid-term, we will always see areal prices converge in major markets.” Other industry analysts and research papers also measure both price and output on an areal basis.<sup>60</sup>

<sup>57</sup> A log linear regression fits slightly better for 2002 and 2004.

<sup>58</sup> Professor Ordovery, an expert for Defendants in the Direct Purchaser Case, filed an expert report concerning Class Certification in which he notes that DisplaySearch “is recognized as a leader in research and consulting on the display market.” (Ordovery Report fn. 21) An expert for the Defendants in the Indirect Purchaser Case, Dean Snyder, used DisplaySearch data extensively in his report (see, e.g., ¶¶63, 68, 70, 74, 88). In his deposition, Dean Snyder agreed that DisplaySearch is the good source of industry data. (Deposition of Edward Snyder p. 107). The Defendants’ files are replete with DisplaySearch Reports. Scott Birnbaum of Samsung testified that DisplaySearch provides valid data used by Samsung. (deposition pp. 243-47). According to Chang Suk Chung of LG, Display Search is a reliable supplier of data. Hinoyuki Morimitsu of Sharp testified that Sharp uses DisplaySearch to examine LCD pricing. (deposition p. 100), Chen of HannStar testified as to HannStar’s use of DisplaySearch information. (dep. pp. 37, 56.) DisplaySearch data is also used in academic research. CPT uses DisplaySearch information. See, e.g., CPT01035878-85; Lee, Kim and Lim, “Dynamic Competition in Technological Investments: An Empirical Examination of the TFT-LCD Panel Industry,” 7/20/2009 use and note that Display Search data is “most widely used in display-related research.” P. 11. (Mr. Lim is associated with Samsung Economic Research Institute.)

<sup>59</sup> “TFT LCD Business Cycles and Trends 21 Sep 05 pp. 10, 13.

<sup>60</sup> See, e.g., Goldman Sachs Global Investment Research, “Global Technology Flat Panel Monitor: August 2004” CPT00056564 at Exhibit 1 - total demand and supply in inches squared, Exhibit 6 -- industry capacity in inches squared; csfb-global\_tft-lcd-0325031.pdf; Global\_TFT-LCDs\_-\_2002\_07\_25\_-\_CSFB[1].pdf, Global TFT-LCDs, Credit Suisse, Areal demand analysis, p. 5, areal supply analysis, p. 8; Pye, “Yield Management in LCD Fabs,” *Information Display*, 11/05, provides an analysis of the relationship of LCD costs as related to area..



46. Five industry level prices are used in the econometric analysis.<sup>61</sup> The first is the average monthly price per square meter of all LCD panels. The second price is the monthly average industry areal price of 12 to 30 inch panels, the panels of interest in this case. In order to ensure that the areal price conversion is not altering the regression results in any significant way, three other prices are also used -- the average monthly price of 14.1 inch panels, of 15 inch panels and of 17 inch panels.<sup>62</sup> These three panel sizes were all subject to specific price discussions at the Crystal Meetings. In addition to these five industry level prices, the regression analysis is done for the AUO average monthly prices for all its LCD panels, for its 12 to 30 inch panels, and for its 14.1 inch, 15 inch, and 17 inch panels.
47. Five different supply variables are used in the regression analysis. The first is the average monthly cost per square meter of producing LCD panels (AVG COST<sub>i</sub>), where *i* refers to the month of the observation. The second supply variable is the industry capacity in square meters (CAP<sub>i</sub>). The third supply variable is the percentage change in capacity from the prior month (%CHNG CAP<sub>i</sub>). The fourth supply variable is the total LCD area produced (AREAI). The final variables relate to the competitive conditions. Two qualitative variables are used for competitive conditions, the first assumes a value of 1 during the months of Price Meetings (PMDUM<sub>i</sub>), the second assumes a value of 1 during Conspiracy Meeting months (CMDUM<sub>i</sub>).<sup>63</sup> Both variables have a value of 0 in other months.
48. Seven demand variables are used. The first two measure the prices of alternatives to LCD panels, the monthly average price of CRT displays (P CRT<sub>i</sub>) and the monthly average price of plasma displays (P PLAS<sub>i</sub>). The remaining five demand variables measure the level of

<sup>61</sup> The Regression Data Appendix describes the exact prices used and how they are constructed.

<sup>62</sup> These are the only panels with a sufficient time series of price information.

<sup>63</sup> According to D.J. Kim of Samsung "Generally they [Samsung and HP] did not discuss the price at the start of the month unless there was a change in market. Prices were typically discussed at the middle of the month." Interview Notes p. 2. This suggests that the Price Meetings would affect prices in the month of the meeting.



consumer demand. The first two relate to the use in notebooks and in computer monitors and are the monthly billings of semiconductors shipped (SCSi) and monthly PC units shipped (PCi). The third relates to the demand for LCD panels used in TVs and is monthly TV shipments (TVi). The last two demand variables measure monthly income (OECD GDPi) and monthly U.S. consumer confidence (CCi).

49. Because of the endogeneity of the quantity variable, the equation is estimated in a linear two stage form of which the first stage is given by<sup>64</sup>

$$\begin{aligned} \text{E4. } Q_i = & c_1 + a * \text{AVG COST}_i + b * \text{CAP}_i + c * \% \text{CHNG CAP}_i + d * \text{PMDUM}_i \\ & + e * \text{CM DUM}_i + f * \text{P CRT}_i + g * \text{P PLAS}_i + h * \text{SCS}_i + i * \text{PC}_i + j * \\ & \text{OECD GDP}_i + k * \text{CC}_i + \varepsilon_{1i}. \end{aligned}$$

The second stage of the estimation is given by

$$\begin{aligned} \text{E5. } P_i = & c_2 + l * \text{AVG COST}_i + m * \text{CAP}_i + n * \% \text{CHNG CAP}_i + o * \text{PMDUM}_i \\ & + p * \text{CM DUM}_i + q * Q_i + \varepsilon_{2i} \end{aligned}$$

<sup>64</sup>Daniel Rubinfeld provides a cogent discussion of the endogeneity issue (“In the multiple regression framework, the expert often assumes that changes in explanatory variables affect the dependent variable, but changes in the dependent variable do not affect the explanatory variables—that is, there is no feedback. In making this assumption, the expert draws the conclusion that a correlation between an explanatory variable and the dependent variable is due to the effect of the former on the latter and not vice versa. Were the assumption not valid, spurious correlation might cause the expert and the trier of fact to reach the wrong conclusion.”) “Reference Guide on Multiple Regression” *Reference Manual on Scientific Evidence, 2nd ed.*, Federal Judicial Center (2000), p. 179-227.

Davis and Garces discuss the endogeneity issue implicit in equation E5. (“In a regression of quantity Q on price P, we often consider P as endogenous since we think (Q,P) pairs tend to be generated by the intersection of demand and a pricing equation (supply curve). In such a situation any demand (or supply) shock will systematically and simultaneously affect both the regressor P and the explained variable Q (reference omitted). ... In such a situation, we might want to explicitly model the full system of equations rather than consider estimation of a single equation. For example, in the demand estimation context we might wish to add a pricing equation (i.e., a “supply” curve). Certainly, making explicit a model of the determinants of the endogenous variable will make clear the reasons and possible solutions to the endogeneity problem.) *Quantitative Techniques for Competition and Antitrust Analysis*, Princeton (2009)

The two stage least squares “solution” to the endogeneity problem is accepted and standard. See, e.g., Wright. *The Tariff on Animal and Vegetable Oils*, New York (1928); Haavelmo “The Statistical Implications of a System of Simultaneous Equations,” *Econometrica* 11 (1943); Koopmans *Statistical Inference in Dynamic Economic Models*, Cowles Commission Monograph 10, New York (1950); Angrist, Imbens, and Rubin. “Identification of Causal Effects Using Instrumental Variables (with comments)” *Journal of the American Statistical Association* (1996); and Angrist, and Krueger, “Instrumental Variables and the Search for Identification: From Supply and Demand to Natural Experiments,” *Journal of Economic Perspectives* (2001).

Two stage least squares has also been utilized in the antitrust context. See, e.g., Porter (1983), op cit.; Brander and Ross, (2006) op cit.; and Finkelstein and Levenbach, (1983), op cit.

where  $c_1$  and  $c_2$  are constants,  $a$  through  $q$  regression coefficients, and  $\varepsilon_1$  and  $\varepsilon_2$  are error terms. The “instruments” for the two stage regression are the demand variables in E4.

50. Initial regression analysis revealed significant autocorrelation of the error terms such that autocorrelation correction procedures were necessary. The Newey-West autocorrelation procedure was implemented.<sup>65</sup> Table 12 summarizes the results of estimating the overcharge through two stage regression estimation of equations E4. and E5.<sup>66</sup> The overcharge results are shown in the Table for each of the five price variables for the industry and for AUO. As expected, the estimated coefficient on the Price Meetings variable is positive in all regressions and generally statistically significant at the 95%+ level.<sup>67</sup> Table 12 also gives the percentage overcharges from the regression analysis. The percentage overcharge is obtained by dividing the estimated Price Meetings coefficients by the average price. As shown, depending on the regression specification, the estimates of the percentage overcharge range from 11% to 21%, with the estimated percentage overcharges averaging 16% using the average prices of all Crystal Meetings participants, and 18% using only the AUO prices.

51. The next step in the estimation of the overcharges collected by the Crystal Meeting Participants is to determine the sales measured by area of 12 to 30 inch LCD panels sold during the Price Meeting periods. The transactions data base obtained from the Crystal Meeting Participants is the basis of the determination. The sales in square meters of panels

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<sup>65</sup> Ordinary least squares (OLS) estimation of the parameters of a model (the “base model”) in the context of autocorrelated errors yields unbiased, consistent estimates of the parameters of interest but typically biased and inconsistent estimates of the standard errors. (Greene, *Econometric Analysis*, 5th ed., Chap. 12) One approach to statistical inference when autocorrelation is present is to estimate the base model by OLS, but to then estimate standard errors which are robust – i.e., consistent even in the presence of autocorrelation of unknown form. A standard procedure for accomplishing this is the Newey-West procedure. See Newey and West, “Automatic Lag Selection in Covariance Matrix Estimation,” *Review of Economic Studies*, (1994); see also, Andrews “Heteroskedasticity and Autocorrelation Consistent Covariance Matrix Estimation,” *Econometrica* (1991); White, “A Heteroscedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroscedasticity,” *Econometrica* (1980).

<sup>66</sup> The regression results are not sensitive to the functional form.

<sup>67</sup> The estimated coefficient on the Conspiracy Meetings variable is generally positive but typically not statistically significant.

where  $c_1$  and  $c_2$  are constants,  $a$  through  $q$  regression coefficients, and  $\varepsilon_1$  and  $\varepsilon_2$  are error terms. The “instruments” for the two stage regression are the demand variables in E4.

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51. The next step in the estimation of the overcharges collected by the Crystal Meeting Participants is to determine the sales measured by area of 12 to 30 inch LCD panels sold during the Price Meeting periods. The transactions data base obtained from the Crystal

<sup>65</sup> Ordinary least squares (OLS) estimation of the parameters of a model (the “base model”) in the context of autocorrelated errors yields unbiased, consistent estimates of the parameters of interest but typically biased and inconsistent estimates of the standard errors. (Greene, *Econometric Analysis*, 5th ed., Chap. 12) One approach to statistical inference when autocorrelation is present is to estimate the base model by OLS, but to then estimate standard errors which are robust – i.e., consistent even in the presence of autocorrelation of unknown form. A standard procedure for accomplishing this is the Newey-West procedure. See Newey and West, “Automatic Lag Selection in Covariance Matrix Estimation,” *Review of Economic Studies*, (1994); see also, Andrews “Heteroskedasticity and Autocorrelation Consistent Covariance Matrix Estimation,” *Econometrica* (1991); White, “A Heteroscedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroscedasticity,” *Econometrica* (1980).

<sup>66</sup> The regression results are not sensitive to the functional form.


<sup>67</sup> The estimated coefficient on the Conspiracy Meetings variable is generally positive but typically not statistically significant.


Meeting Participants is the basis of the determination. The sales in square meters of panels 12 to 30 inches during the Price Meetings period for all Crystal Meeting Participants total 28.1 million square meters.

52. The final step of the overcharge estimation is simple multiplication of the best estimate of the overcharge per square meter of \$439, the all Crystal Meeting Participants panels 12 to 30 inch regression coefficient, by the total areal purchases from the Crystal Meetings Participants during the Price Meeting period. The results of this multiplication are \$12.3 billion, and this is the estimated overcharges from the Crystal Meetings conspiracy.

### **Conclusion**

53. Based on the analysis described above, I have reached the opinions that: 1) the Crystal Meetings conspiracy was effective in raising prices above the competitive levels; 2) that as a result the Crystal Meeting Participants overcharged purchasers by over \$12 billion.

  
\_\_\_\_\_  
Keith Leffler

  
\_\_\_\_\_  
Date

**Table 1**  
**Capital Costs for Various Generation Fabrication Plants**

GENERATION	EQUIPMENT (M)	FACILITIES/LAND (M)	TOTAL (M)
5	\$899	\$467	\$1,366
5.5	\$925	\$499	\$1,423
6	\$1,220	\$666	\$1,886
7	\$1,611	\$901	\$2,512
8	\$2,083	\$1,191	\$3,274
9	\$2,622	\$1,483	\$4,105
10	\$2,914	\$1,667	\$4,581

**Table 2**  
**Quarterly Worldwide Sales of LCD Panels 12.1" and Larger, by Use**

Period	Monitor Panels	Notebook Panels	TV Panels	Other Panels	TOTAL
Q4 2001	7,042,200	7,188,300	188,880	315,300	14,734,680
Q1 2002	8,062,800	7,376,700	240,600	351,600	16,031,700
Q2 2002	8,871,000	7,998,000	309,900	428,700	17,607,600
Q3 2002	8,645,400	6,748,500	393,000	489,900	16,276,800
Q4 2002	9,929,700	7,547,700	606,300	604,800	18,688,500
Q1 2003	11,288,100	7,524,300	714,900	587,400	20,114,700
Q2 2003	13,075,500	8,631,000	861,300	521,400	23,089,200
Q3 2003	14,267,500	10,469,400	1,341,800	679,600	26,758,300
Q4 2003	15,221,300	11,940,000	2,090,400	720,000	29,971,700
Q1 2004	17,539,200	11,287,500	2,347,500	905,100	32,079,300
Q2 2004	19,493,100	10,686,900	2,892,000	1,103,400	34,175,400
Q3 2004	17,549,000	11,621,000	3,113,000	1,264,000	33,547,000
Q4 2004	20,020,000	13,484,000	3,822,000	1,378,000	38,704,000
Q1 2005	24,163,000	12,779,000	4,315,000	1,671,000	42,928,000
Q2 2005	28,289,700	13,901,700	5,978,700	1,848,600	50,018,700
Q3 2005	32,848,000	17,036,000	7,847,000	2,033,000	59,764,000
Q4 2005	32,907,000	19,766,000	10,119,000	2,711,000	65,503,000
Q1 2006	29,877,100	18,513,500	11,224,000	2,586,700	62,201,300
Q2 2006	31,784,900	18,109,600	11,889,500	2,374,768	64,158,768
Q3 2006	39,126,800	20,728,800	14,887,000	2,666,300	77,408,900
Q4 2006	39,329,900	22,420,400	16,411,600	2,493,333	80,655,233
Q1 2007	37,527,000	22,868,400	15,764,600	2,829,641	78,989,641
Q2 2007	45,328,400	27,054,100	20,715,000	2,889,014	95,986,514
Q3 2007	48,263,700	31,882,700	25,178,100	3,454,000	108,778,500
Q4 2007	46,286,100	32,342,100	31,084,700	3,435,000	113,147,900
Q1 2008	46,883,500	32,888,200	27,946,100	3,901,370	111,619,170
Q2 2008	49,514,000	37,091,000	27,850,500	3,347,520	117,803,020
Q3 2008	43,395,800	36,771,000	30,769,900	5,119,770	116,056,470
Q4 2008	33,780,500	28,201,000	26,383,600	5,484,529	93,849,629
Q1 2009	34,651,300	22,911,400	26,654,800	7,075,219	91,292,719
Q2 2009	47,136,400	33,164,900	38,903,900	10,541,592	129,746,792
Q3 2009	49,635,300	41,815,500	46,074,700	14,245,007	151,770,507
Q4 2009	45,577,000	43,108,200	51,366,600	13,238,182	153,289,982

Source: Display Search Quarterly Large Area TFT-LCD Shipment Report

**Table 3**  
**Quarterly Worldwide Unit Sales of CRT, LCD, and PDP Displays**

Period	CRT Displays	LCD Displays	PDP Displays	TOTAL
Q4 2001	68,805,288	13,782,778	74,955	82,663,021
Q1 2002	53,198,000	15,076,300	114,638	68,388,938
Q2 2002	56,680,000	15,551,500	141,298	72,372,798
Q3 2002	63,523,000	14,685,800	170,624	78,379,424
Q4 2002	70,183,000	17,903,600	203,949	88,290,549
Q1 2003	53,242,000	18,865,200	239,940	72,347,140
Q2 2003	56,446,000	20,163,000	277,264	76,886,264
Q3 2003	58,684,000	24,541,600	327,918	83,553,518
Q4 2003	54,057,000	28,952,200	706,490	83,715,690
Q1 2004	52,586,748	28,530,072	643,639	81,760,459
Q2 2004	52,244,892	27,332,796	794,876	80,372,564
Q3 2004	54,959,472	30,643,900	735,982	86,339,354
Q4 2004	70,179,008	38,322,080	1,173,454	109,674,542
Q1 2005	52,407,024	38,641,356	966,477	92,014,857
Q2 2005	45,923,124	41,527,656	1,197,908	88,648,688
Q3 2005	47,518,588	50,874,368	1,659,921	100,052,877
Q4 2005	56,848,632	59,788,756	2,448,552	119,085,940
Q1 2006	43,616,288	54,903,920	1,883,189	100,403,397
Q2 2006	38,400,908	57,366,044	2,364,775	98,131,727
Q3 2006	39,056,232	66,244,912	2,457,982	107,759,126
Q4 2006	41,983,424	78,637,400	3,245,110	123,865,934
Q1 2007	33,240,356	73,863,792	2,476,655	109,580,803
Q2 2007	28,845,764	83,169,656	2,358,382	114,373,802
Q3 2007	31,154,822	95,004,752	2,948,865	129,108,439
Q4 2007	31,923,752	103,853,424	4,154,698	139,931,874
Q1 2008	25,155,620	96,586,456	2,940,356	124,682,432
Q2 2008	23,929,930	103,901,304	3,522,704	131,353,938
Q3 2008	25,094,750	106,642,808	3,919,024	135,656,582
Q4 2008	20,801,458	101,313,648	4,570,157	126,685,263
Q1 2009	14,222,762	88,281,592	2,923,443	105,427,797
Q2 2009	11,849,638	103,939,520	3,197,541	118,986,699
Q3 2009	14,000,413	120,326,608	3,724,947	138,051,968
Q4 2009	11,353,945	129,786,752	4,595,053	145,735,750

Sources:

Monitors: Display Search Quarterly Desktop Monitor Shipment and Forecast Report

LCD Notebook: Display Search Quarterly Large Area TFT-LCD Shipment Report

TV: See Regression Data Appendix, variable *tvunits*.

PDP includes public display PDP units from same data sources as *tvunits*.

**Table 4****LCD Large Panel Sizes Produced in Each LG Fabricating Plant for Selected Months**

<b>LG LCD Fab</b>	<b>Mother Glass Size (mm)</b>	<b>Jun-02</b>	<b>Jun-03</b>	<b>Jun-04</b>	<b>Jun-05</b>	<b>Jun-06</b>
LGP Kumi P1	370 x 470	14.1 15.2	14.1	14.1 15.4	14.1 15.4	15.4
LGP Kumi P2	590 x 670	12.1 13.3 14.1 15 15.7 23	12.1 13 13.3 14.1 15 23	12.1 14.1 15 23	14.1 15 23	13.3 15
LGP Kumi P3	680 x 880	15 15.1 17.1 20.1	15 15.1 17.1 20.1 30	15 15.4 17.1 20.1	15 15.4 20.1	14.1 15 15.4 20.1 30
LGP Kumi P4	1000 x 1200	15 18.1	15 17 17.1 18.1	15 17.1 18.1 19	15 17.1 19 23	15 17.1 19 23
LGP Kumi P5	1100 x 1250		17	15 17 20.1 26 30	15 15.4 17 20 23 26 30	15 17 20 23 26 47
LGP Kumi P6	1500 x 1850				17 20.1 32 37 42	17 20.1 26 32 37
LGP Paju P7	1950 x 2250					20.1 42 47

Sources: GRNE0322367 Re Production Cost (CY2002-2005).XLS, GRNE0322369\_Production Cost (CY2006).XLS

NOTE: A Panel Size is reported if it was greater than 12 inches in diagonal size and if it comprised at least 1.0% of all units produced in that month.



Table 5A

## LCD Panels Offered by 3 or More Crystal Meeting Participants

Year	Screen Size	Use	Resolution	Percent of Total Units in Year	Participants' Share of All Units in Year
2001	13.3	NB	XGA	7.2%	74.5%
	14.1	NB	XGA	30.7%	
	15	Monitor	XGA	26.9%	
	15	NB	XGA	5.4%	
	17	Monitor	SXGA	4.3%	
2002	14.1	NB	XGA	23.7%	82.8%
	15	NB	UXGA	0.2%	
	15	Monitor	XGA	39.1%	
	15	NB	XGA	9.2%	
	17	Monitor	SXGA	10.6%	
2003	14.1	NB	XGA	12.5%	80.7%
	15	NB	UXGA	0.3%	
	15	Monitor	XGA	26.6%	
	15	NB	XGA	15.2%	
	15.4	NB	WXGA	2.2%	
	17	Monitor	SXGA	21.4%	
	19	Monitor	SXGA	2.4%	
2004	14.1	NB	XGA	7.5%	84.6%
	15	NB	SXGA+	0.4%	
	15	NB	UXGA	0.1%	
	15	Monitor	XGA	19.9%	
	15	NB	XGA	12.4%	
	15.4	NB	WXGA	4.5%	
	17	Monitor	SXGA	30.6%	
	19	Monitor	SXGA	7.8%	
	20.1	TV	VGA	1.5%	
2005	12.1	NB	XGA	1.0%	85.2%
	14	NB	WXGA	1.4%	
	14.1	NB	WXGA	0.2%	
	14.1	NB	XGA	3.9%	
	15	NB	SXGA+	0.3%	
	15	Monitor	XGA	9.1%	
	15	NB	XGA	8.0%	
	15.4	NB	WXGA	6.6%	
	17	Monitor	SXGA	33.2%	
	17	NB	WXGA+	0.6%	
	19	Monitor	SXGA	14.5%	
	20.1	Monitor	UXGA	1.0%	
	20.1	TV	VGA	2.0%	
	23	TV	WXGA	0.3%	
	26	TV	WXGA	1.2%	
	32	TV	WXGA	1.8%	
	12.1	NB	WXGA	0.3%	

2006	12.1	NB	XGA	0.5%	78.3%
	13.3	NB	WXGA	0.8%	
	14	NB	WXGA	0.6%	
	14.1	NB	WXGA	2.8%	
	14.1	NB	WXGA+	0.5%	
	14.1	NB	XGA	2.3%	
	15	NB	SXGA+	0.2%	
	15	Monitor	XGA	4.9%	
	15	NB	XGA	3.2%	
	15	TV	XGA	0.5%	
	15.4	NB	WXGA	9.6%	
	17	Monitor	SXGA	25.7%	
	17	NB	WXGA+	0.7%	
	19	Monitor	SXGA	13.8%	
	19	Monitor	WXGA+	1.6%	
	20.1	Monitor	UXGA	0.8%	
	20.1	TV	VGA	2.2%	
	23	TV	WXGA	0.2%	
	24	Monitor	WUXGA	0.4%	
	26	TV	WXGA	1.6%	
	32	TV	WXGA	3.6%	
	37	TV	WXGA	1.6%	
2007	12.1	NB	WXGA	0.5%	70.0%
	13.3	NB	WXGA	1.4%	
	14	NB	WXGA	0.0%	
	14.1	NB	WXGA	4.5%	
	14.1	NB	WXGA+	0.7%	
	14.1	NB	XGA	1.1%	
	15	Monitor	XGA	2.0%	
	15	NB	XGA	1.0%	
	15.4	NB	WXGA	12.2%	
	15.4	NB	WXGA+	0.6%	
	17	Monitor	SXGA	12.7%	
	17	Monitor	WXGA	1.2%	
	17	NB	WXGA+	1.2%	
	19	Monitor	SXGA	9.3%	
	19	Monitor	WXGA	4.6%	
	19	Monitor	WXGA+	4.8%	
	20.1	Monitor	UXGA	0.7%	
	20.1	TV	VGA	1.0%	
	23	TV	WXGA	0.3%	
	24	Monitor	WUXGA	0.8%	
	26	TV	WXGA	2.8%	
	32	TV	WXGA	3.2%	
	37	TV	WXGA	1.9%	
	42	TV	WXGA	1.4%	
	12.1	NB	WXGA	0.4%	
	13.3	NB	WXGA	2.0%	
	14	NB	WXGA	0.1%	

2008	14.1	NB	WXGA	5.9%	48.5%
	14.1	NB	WXGA+	0.7%	
	14.1	NB	XGA	0.2%	
	15	Monitor	XGA	1.0%	
	15	NB	XGA	0.3%	
	15.4	NB	WSXGA+	0.3%	
	15.4	NB	WXGA	11.2%	
	15.4	NB	WXGA+	0.7%	
	17	Monitor	SXGA	7.2%	
	18.5	Monitor	WXGA	1.0%	
	19	Monitor	SXGA	6.0%	
	19	Monitor	WXGA	4.6%	
	19	Monitor	WXGA+	5.2%	
	20.1	Monitor	UXGA	0.3%	
	20.1	TV	VGA	0.3%	
	22	Monitor	WUXGA	0.1%	
	24	Monitor	WUXGA	1.1%	
	26	Monitor	WUXGA	0.1%	
	26	TV	WXGA	3.1%	
	32	TV	WXGA	2.6%	
	37	TV	WXGA	1.4%	
	42	TV	WXGA	0.9%	
2009	12.1	NB	WXGA	0.5%	35.4%
	13.3	NB	WXGA	2.5%	
	14.1	NB	WXGA	4.9%	
	15	Monitor	XGA	0.2%	
	15.4	NB	WSXGA+	0.2%	
	15.4	NB	WXGA	3.5%	
	15.4	NB	WXGA+	0.8%	
	17	Monitor	SXGA	4.0%	
	19	Monitor	SXGA	4.0%	
	22	Monitor	WSXGA+	4.6%	
	23	Monitor	WUXGA	0.7%	
	24	Monitor	WUXGA	0.9%	
	26	Monitor	WUXGA	0.3%	
	26	TV	WXGA	3.6%	
	32	TV	WXGA	3.6%	
	37	TV	WXGA	1.3%	

Sources: AUO, CMO, CPT, HannStar, LG, Samsung Invoices Datasets

NOTES: Shares for 2001 and 2009 are underestimated because of missing AUO data in those years. A company is counted as a competitor if it sold at least 2400 units in a year. Products listed are ones for which unit sales were at least 14,400 units in a year.

**Table 5B****Panels for Which Dell or HP had Multiple Suppliers**

<b>Company</b>	<b>Year</b>	<b>Panel Size</b>	<b>Use</b>	<b>Resolution</b>	<b>Number of Suppliers</b>
DELL	2002	15	NB	XGA	2
	2003	15	NB	XGA	2
	2004	14.1	NB	XGA	2
	2004	15	Monitor	XGA	2
	2004	15	NB	XGA	3
	2004	17	Monitor	SXGA	2
	2005	14.1	NB	XGA	4
	2005	15	Monitor	XGA	3
	2005	15	NB	XGA	3
	2005	15.4	NB	WXGA	2
	2005	17	Monitor	SXGA	4
	2005	19	Monitor	SXGA	4
	2006	14.1	NB	WXGA	2
	2006	14.1	NB	XGA	3
	2006	15	Monitor	XGA	3
	2006	15.4	NB	WXGA	2
	2006	17	Monitor	SXGA	4
	2006	19	Monitor	SXGA	4
	2007	14.1	NB	WXGA	3
	2007	14.1	NB	WXGA+	2
	2007	15.4	NB	WXGA	2
	2007	17	Monitor	SXGA	4
	2007	19	Monitor	SXGA	5
	2007	19	Monitor	WXGA+	2
	2008	14.1	NB	WXGA	3
	2008	15.4	NB	WXGA	3
	2008	17	Monitor	SXGA	3
	2008	19	Monitor	SXGA	5
	2008	19	Monitor	WXGA+	2
	2008	22	Monitor	WSXGA+	2
	2002	14.1	NB	XGA	3
	2002	15	NB	SXGA+	2
	2002	15	NB	UXGA	2
	2002	15	NB	XGA	4
	2003	14.1	NB	XGA	2
	2003	15	NB	XGA	4
	2004	14	NB	WXGA	2
	2004	14.1	NB	XGA	2
	2004	15	NB	XGA	4
	2004	15.4	NB	WXGA	2
	2005	14	NB	WXGA	3
	2005	14.1	NB	XGA	2
	2005	15	NB	XGA	3

HP	2005	17	NB	WXGA+	2
	2006	14	NB	WXGA	3
	2006	14.1	NB	WXGA	3
	2006	14.1	NB	XGA	3
	2006	15	NB	XGA	3
	2006	15.4	NB	WXGA	3
	2006	17	NB	WXGA+	3
	2007	12.1	NB	WXGA	2
	2007	14.1	NB	WXGA	3
	2007	14.1	NB	WXGA+	2
	2007	15.4	NB	WXGA	3
	2007	17	NB	WXGA+	2
	2008	14.1	NB	WXGA	2
	2008	15.4	NB	WXGA	3
	2008	15.6	NB	WXGA	2
	2008	17	Monitor	SXGA	4
	2008	17	NB	WXGA+	2

Sources: AUO, CMO, CPT, HannStar, LG, Samsung Invoices Datasets

NOTES: A supplier is counted if it sold at least 2400 units of the panel to the customer in a given year. Years 2001 and 2009 are excluded from the analysis because the invoice data for at least one of the six suppliers is incomplete or missing.

**Table 6**  
**Summary of Crystal Meetings**

Date of Meeting	Participants	Price Discussions
9/14/01	AUO: C.S. Tuan Steve Wang CMO: J.Y. Ho H.T. Wang  Amigo Huang  CPT: C.C. Liu Brian Lee HannStar: L.P. Hsu Ching-Hwei Wu  SET: Hung-Chih Chao LGP Stanley Park	Yes for Oct 2001
9/21/01	AUO: Steve Wang  Tai-Yuan Hsiao  CMO: H.T. Wang C.E. Wang  Amigo Huang  CPT: C.C. Liu Brian Lee HannStar: David Joe Sam Wu LG: Stanley Park  Samsung:	Yes

	Harry Cho	
10/5/01	AUO: Hb Chen, Hui Hsiung, David Chu, Tyler Shiau  CMO: H.T. Wang JY Ho CPT: CY Lin CC Liu Tony Cheng  Brian Lee LG: Stanley Park  Bock Kwon  Hannstar: LP Hsu Sam Wu	Yes
10/19/01	AUO: H.B. Chen Hui Hsiung  David Chu Tyler Shiau  CMO: J.Y. Ho H.T. Wang CPT: C.Y. Lin C.C. Liu Brian Lee HannStar: L.P. Hsu Sam Wu LG: Bock Kwon  Stanley Park  Samsung: H.S. Kim H S Cho	Yes
	AUO: TY Hasiao CMO:	

10/30/01	H.T. Wang CPT: C.C. Liu Tony Cheng  Brian Lee HannStar: TH Chou CH Wu Samuel Lin  LG: Stanley Park  Samsung Harry Cho SEC: Harry Cho	Yes
11/6/01	CPT: Yin-Hau (aska) Hsu, Hsueh-Ju (Sharon) Wu CMO: Zhi-Xuan Wang HS: YZ Cheng YR Chen AU: JZ Zhu SS: Yun-Ru Chen	Yes
11/13/01	AUO CMO CPT HannStar LG Stanley Park  Samsung (Top management people from most of the Waiwan companies plan to attend, Mr Hun Sung Kim at SS plans to attend)	Yes
	AUO: H.B. Chen KT Chu, TY Shiau	



11/15/01	CMO: Chao Yang Ho  H.T. Wang WH Huang  CPT: C.Y. Lin C.C. Liu Tony Cheng  Brian Lee HannStar: L.P. Hsu Wilson Wen  CH Wu LG: Champ Shin  Chuan-Fu Stanley Park  Sec: S.R. Kim <i>Hsian-Cheng Chin</i>  Harry Cho	Yes
12/5/01	CMO: ZH Wang. HS: YZ Cheng Ying-Ru  AUO: Zhen Guo Liado  Jian-Zhong Zhu,  SS: Yan-Dong XU Yun-Ru	Yes
'01	AUO: Tyler Shiau  Joe Tsui CMO: H.T. Wang C.E. Wang CPT: C.C. Liu Brian Lee	

12/7/	<p>HannStar: TH Chou Sam Wu Samuel Lin</p> <p>LG: Stanley Park</p> <p>SEC: Harry Cho</p>	Yes
12/11/01	<p>AUO: H.B. Chen Hwei-Hwiung</p> <p>David Chu CMO: H.T. Wang C.E. Wang CPT: C.Y. Lin C.C. Liu Brian Lee HannStar: L.P. Hsu Wilson Wen</p> <p>Sam Wu Samuel Lin</p> <p>LG: Chu, Chuan-Fu Stanley Park</p> <p>SEC: D.H. Lee S.R. Kim Harry Cho</p>	Yes
1/3/02	<p>CMO: ZX Wang ZH Qin</p> <p>HS: YZ Cheng Ying-Ru</p> <p>AU: Zhen-Guo Liao Jian-Zhong Zhu</p>	Yes

	SS: Yan Dong Xu, Yun-Ru Chen  Hydix: JianZhong Yang	
1/11/02	AUO:  Tyler Shiau  Hubert Lee CMO: H.T. Wang CPT: C.C. Liu Brian Lee HannStar: David Joe Samuel Lin  Sam Wu LG: Stanley Park.  Samsung: Harry Cho	Yes
2/6/02	AUO:  Kuma Tyler Shiau  Hubert Lee CMO: H.T. Wang CPT: C.C. Liu Tony Cheng  Brian Lee HannStar: Sam Wu Samuel Lin  <i>Peter Laio</i> LG: Stanley Park	Yes
	AUO:	

2/11/02	<p>Tyler Shiau</p> <p>Hubert Lee</p> <p>CMO:</p> <p>H.T. Wang</p> <p>CPT:</p> <p>C.C. Liu</p> <p>Brian Lee</p> <p>Hannstar:</p> <p>David Joe</p> <p>Sam Wu</p> <p>Samuel Lin</p> <p>Samsung:</p> <p>Harry Cho</p> <p>LG</p> <p>Stanley Park</p>	Yes
2/20/02	<p>CPT Yin-Hua (Asuka) Hsu</p> <p>Hsueh-Ju (Sharon) Wu</p>	Yes
3/8/02	<p>AUO:</p> <p>Kuma</p> <p>Tyler Shiau</p> <p>Hubert Lee</p> <p>CMO:</p> <p>H.T. Wang</p> <p>C.E. Wang</p> <p>CPT:</p> <p>Yin-Hua Hsu Hsueh-Ju Wu</p> <p>C.C. Liu</p> <p>Tony Cheng</p> <p>Brian Lee</p> <p>HannStar:</p> <p>Samuel Lin</p> <p>Sam Wu</p> <p>LG:</p> <p>Stanley Park</p> <p>Samsung:</p> <p>Harry Cho</p>	Yes
	<p>AUO:</p> <p>H.B. Chen</p> <p>Hwei-Hsiung</p>	

3/13/02	David Chu  CMO: H.T. Wang  C.E. Wang CPT:  C.Y. Lin Tony Cheng  Brian Lee HannStar: Sam Wu LG: DukeChu Chuan Fu Stanley Park  Samsung: D.H. Lee Harry Cho	Yes
4/10/02	AUO: TY Hsiao Joe Tsui  CMO: H.T. Wang  C.E. Wang CPT: C.C. Liu Brian Lee HannStar: Sam Wu Sam Huang  LG: Stanley Park  Samsung: Harry Cho	Yes
5/3/02	Zhi-Xuan Wang (cmo) YR Chen (HS) YR Chen (SS) GH Zheng (Hydis) JZ Zhu (AU) YH Hsu (CPT)	Yes

5/15/02	AUO: Steven Leung  Joe Tsui  Hubert Lee <i>Stanley Cheng</i>  <i>Vincent Cheng</i>  Tyler Shiau  CMO: H.T. Wang Amigo Huang  CPT: C.C. Liu Brian Lee HannStar: David Joe Sam Wu Samuel Lin  LG: Stanley Park  Samsung: Harry Cho	Yes
6/5/02	AUO: David Chu,  Steven Leung  Hubert Lee CMO: H.T. Wang CPT: C.C. Liu Brian Lee HannStar: Sam Wu Samuel Lin  LG: Stanley Park;  Samsung: Harry Cho;	Yes
	CMO	

6/26/02	H.T. Wang Tim Wang LG HS	Yes
7/4/02	AUO: David Chu Kuma  CMO: H.T. Wang  CPT: C.Y. Lin C.C. Liu Brian Lee HannStar: Wilson Wen  David Joe Sam Wu LG: Stanley Park	Yes
7/22/02	AUO: David Chu Steven Leung  CMO: C.E. Wang CPT: C.C. Liu Brian Lee Tony Cheng  HannStar: David Joe Sam Wu <i>Peter Liao</i> LG: Stanley Park  Samsung: Harry Cho	Yes
	AUO Kuma  Steven Leung  Hubert Lee  CMO H.T. Wang	

8/15/02	C.E. Wang Amigo Huang  CPT C.C. Liu Brian Lee Tony Cheng  HannStar: Sam Wu Samuel Lin  <i>Peter Liao</i> LG Stanley Park  Samsung Harry Cho	Yes
9/13/02	AUO: Steven Leung  Hubert Lee CMO: H.T. Wang CPT: C.C. Liu Brian Lee HannStar: Sam Wu Samuel Lin  LG: Stanley Park  Samsung: Harry Cho	No
#####		No
11/8/02	AUO Steven Leung  CMO HT Wang CPT CC Liu Tony Cheng  Hannstar Samuel Lin  LG	Yes



	Stanley Park  Samsung Harry Cho	
12/4/02	AUO BH Kuma CMO HT Wang CPT CC Liu CY Brian Tony Cheng  Hannstar <i>Harry</i> LG Stanley Park  Samsung Harry Cho	Yes
12/19/02	AUO: HB Chen Kuma CMO: H.T. Wang CPT: CY Lin C.C. Liu Brian Lee HannStar: TK Wu LG: Stanley Park  Samsung: Sung Yeol Kim	Yes
3	AUO:  J.C. Wang Jane Chen Steven Leung  CMO: H.T. Wang CPT: C.C. Liu Tony Cheng	

1/9/0:	Morgan Tai  HannStar: David Joe Sam Wu Sam Huang  Samuel Lin  LG: Stanley Park  Samsung: Harry Cho	Yes
2/13/03	CMO HannStar AUO Steven Leung  Samsung LG CPT	Yes
3/20/03	AUO: Steven Leung  Others-Richard Bai  CMO: H.T. Wang  CPT: C.C. Liu Tony Cheng  Brian Lee HannStar: Sam Wu Andrew Cheng  LG: Stanley Park  Samsung: Harry Cho,  Samuel Lin	Yes
	AUO: J.C. Wang,  Steven Leung	

4/11/03	CMO:  H.T. Wang CPT: Tony Cheng  HannStar: Sam Wu, <i>Kai-fang Cheng</i> -Andrew Cheng  <i>Qiong-yu Liang</i> -Susy Liang  LG: Stanley Park  Samsung: Harry Cho Sonia Chen	Yes
5/14/03	CMO HannStar AUO: Steven Leung  Samsung CPT LPL	Yes
6/11/03	AUO: Steven Liang  Etc. -- CMO: H.T. Wang;  CPT: C.C. Liu Tony Cheng  Brian Lee HannStar: Susy Liang LG: Stanley Park  SEC: Harry Cho Samuel Lin	Yes
	AUO:	

7/9/03	<p>Steven Leung</p> <p>Others --</p> <p>CMO:</p> <p>H.T. Wang</p> <p>CPT:</p> <p>C.C. Liu</p> <p>Tony Cheng</p> <p>Brian Lee</p> <p>HannStar:</p> <p>Susy Liang</p> <p>Others --</p> <p>LGP:</p> <p>Stanley Park;</p> <p>Sec</p> <p>Harry Cho</p> <p>Samuel Lin</p>	Yes
8/5/03	<p>AUO:</p> <p>Steven Leung</p> <p>Morris Wong</p> <p>CMO:</p> <p>H.T. Wang</p> <p>CPT:</p> <p>Tony Cheng</p> <p>Alex Yeh</p> <p>Asuka Hsu</p> <p>HannStar:</p> <p>Andrew Cheng</p> <p>Sam Wu</p> <p>Susy Liang</p> <p>LPL:</p> <p>Stanley Park;</p> <p>Sec:</p> <p>Harry Cho</p> <p>Samuel Lin</p>	Yes
9/4/03	<p>AUO</p> <p>Morris Wong</p> <p>CMO</p> <p>CPT</p> <p>HannStar</p> <p>LG</p>	Yes

	Samsung	
10/3/03	AUO: Morris Wong  Ernest Liao  CMO: H.T. Wang  CPT: Tony Cheng  Brian Lee HannStar: Andrew Cheng  Lpl: Stanley Park  Samsung: Harry Cho Samuel Lin	Yes
11/3/03	AUO Morris Wong  CMO  CPT Brian Lee HannStar LPL Sec	Yes
12/10/03	AUO  Morris Wong  Steven Leung  CMO Mark Chin  CPT Tony Cheng  HannStar Susy Liang LG Stanley Park  Samsung Harry Cho	Yes

	Sonia Chen	
1/16/04	AUO:  Samuel Lin  Morris Wong  Steven Leung  Sylvania Hung  CMO: H.T. Wang Mark Chen  CPT: C.C. Liu Tony Cheng  Brian Lee HannStar: Tony Chien  Andrew Cheng  Sam Wu LG: Stanley Park  Sec: Harry Cho Sonia Chen	Yes
2/3/04	AUO  CMO Mark Chin  CPT HannStar  LG Samsung Sonia Chen	Yes
	AUO Morris Wong  Sylvania Hung Samuel Lin  CMO Mark Chin	

3/5/04	CPT  Tony Cheng  HannStar  LPL Samsung Sonia Chen	Yes
4/2/04	AUO  Morris Wong  Sylvania Hung  Samuel Lin  CMO CPT HannStar  LG Stanley Park  Samsung Sonia Chen	Yes
5/6/04	AUO Morris Wong  Sylvania Hung  CMO H.T. Wang Anita Huang  Mark Chin  CPT Tony Cheng  Brian Lee HannStar  Sam Wu Andrew Cheng  Susy Liang LG	Yes

	Stanley Park  Samsung Harry Cho Sonia Chen	
6/4/04	AUO CMO Anita Huang  CPT Brian Lee  HannStar LG  Stanley Park  Samsung	Yes
7/8/04	AUO  CMO CPT HannStar LG Stanley Park  Samsung	Yes
7/21/04	AUO:  Kuma Morris Wong  Sylvania Hung  CMO: James Yang  CPT: C.C. Liu Tony Cheng  Alex Yeh HannStar: Marty Chiou  Andrew Cheng  LG: Stanley Park  Samsung:	Yes



	Harry Cho	
8/10/04	AUO  CMO CPT HannStar LG Stanley Park  Samsung	Yes
9/3/04	AUO  CMO Anita Huang  CPT Hannstar  Stanley Park  Samsung	Yes
10/6/04	AUO  CMO Anita Huang  CPT Hannstar LG Samsung	Yes
11/4/04	AUO  CMO Anita Huang CPT LG  Stanley Park  Samsung	No
	AUO	

12/8/04	CMO Anita Huang CPT HannStar LG Stanley Park  Samsung	Yes
1/7/05	AUO  Irene Chang  CMO Anita Huang  CPT  HannStar LG Stanley Park  Samsung Sonia Chen	Yes
2/3/05	AUO CMO Anita Huang CPT Hannstar LG Samsung Sonia Chen	No
3/4/05	AUO CMO Anita Huang CPT HannStar LG Stanley Park	Yes

	Samsung Sonia Chen	
4/6/05	AUO CMO Anita Huang  CPT Hannstar LG Samsung	Yes
5/5/05	CMO  H.T. Wang Anita Huang  CPT HannStar  LG Stanley Park  Samsung Harry Cho  Sonia Chen	Yes
6/14/05	AUO CMO Anita Huang  CPT Yvonne Yun  HannStar LG  Stanley Park  Samsung Sonia Chen	Yes
	AUO: Irene Chang  CMO:	

7/8/05	Anita Huang  CPT:  Milton Kuan  HannStar: <i>Vincent Lau</i>  LG: Stanley Park  Vera Wang  Samsung: Sonia Chen	Yes
8/4/05	AUO:  Irene Chang  Meng Yueh Wu  CMO: Anita Huang  CPT: Yvonne Yun  HannStar: Nancy Huang  Kevin Chang  LG:  Vera Wang  Samsung: Sonia Chen	Yes
	AUO: Irene Chang  CMO: Anita Huang  Shawn Ko  CPT:	

9/6/05	Yvonne Yun Milton Kuan HannStar: Nancy [Huang]. LG: Vera Wang Samsung: Sonia Chen	Yes
10/6/05	CMO: Anita Huang  Shawn Ko Jiayu Ong CPT:  Yvonne Yun Milton Kuan HannStar: Nancy Huang  Kevin Chang  LG: Vera Wang  Samsung: Sonia Chen	Yes
10/13/2005	AUO CMO CPT	Yes
1/4/05	CMO: Anita Huang  CPT: Milton Kuan  HannStar: Nancy Huang	Yes

1	<p>Tony Chien</p> <p>LG: Vera Wang</p> <p>Samsung: Sonia Chen</p>	
12/6/05	<p>AUO: Irene Chang</p> <p>CMO: Anita Huang</p> <p>CPT:  Milton Kuan</p> <p>HannStar:  Nancy Huang</p> <p>Tony Chien</p> <p>LG: Vera Wang</p> <p>Samsung: Sonia Chen</p>	Yes
1/6/06	<p>AUO CMO CPT Morgan Tai</p> <p>HannStar</p> <p>LG Daniel Lee</p> <p>Samsung Sonia Chen</p>	Yes
ox.)	<p>AUO CMO Jiayu Ong Shawn Ko</p>	

2/1/06 (approx.)	CPT  HannStar LG  Samsung	No
3/1/06 (approx.)	AUO CMO Shawn Ko  CPT LG Quanta Samsung	No
4/4/06	AUO Irene Chang CMO Shawn Ko CPT Milton Kuan LG Vera Wang Samsung Sonia Chen	No
5/8/06	AUO CMO Shawn Ko CPT Milton Kuan LG Vera Wang Samsung Sonia Chen	No
6/1/06 (approx.)	AUO CMO Shawn Ko  CPT LG Quanta Samsung	No

**Table 7****Correlations Between Crystal Meeting Prices and Actual Panel Prices**

	<b>6-Firm Crystal Price and 6-Firm Transactions Price</b>		<b>AUO Crystal Price and AUO Transactions Price</b>	
<b>Product</b>	<b>Levels</b>	<b>First Differences</b>	<b>Levels</b>	<b>First Differences</b>
14.1" XGA Notebook	0.979	0.562	0.953	0.414
15" XGA Monitor	0.980	0.692	0.944	0.372
15" XGA Notebook	0.984	0.675	0.980	0.425
17" SXGA Monitor	0.988	0.733	0.989	0.712
19" SXGA Monitor	0.991	0.641	0.984	0.562

Sources: AUO, CMO, CPT, HannStar, LG, Samsung Invoices Datasets, crystal\_prices\_products.xlsx

NOTES: Listed products are the top 5 products (measured by total unit sales of products for which there were Crystal Prices).



**Table 8****AUO's Percent of Volume from Crystal Meeting Products**

<b>Year</b>	<b>Month</b>	<b>Percent of Volume</b>
2001	10	93.5%
2001	11	100.0%
2001	12	100.0%
2002	1	100.0%
2002	2	100.0%
2002	3	100.0%
2002	4	100.0%
2002	5	95.9%
2002	6	96.0%
2002	7	95.8%
2002	8	96.6%
2002	9	CM
2002	10	CM
2002	11	NM
2002	12	96.9%
2003	1	94.4%
2003	2	96.0%
2003	3	96.9%
2003	4	96.2%
2003	5	96.6%
2003	6	96.7%
2003	7	96.8%
2003	8	97.1%
2003	9	95.7%
2003	10	95.6%
2003	11	97.1%
2003	12	74.6%
2004	1	95.2%
2004	2	94.8%
2004	3	95.8%
2004	4	93.6%
2004	5	95.3%
2004	6	94.8%
2004	7	92.0%
2004	8	83.5%
2004	9	81.9%
2004	10	80.5%
2004	11	CM
2004	12	59.5%
2005	1	75.7%
2005	2	CM
2005	3	74.0%
2005	4	54.7%

2005	5	74.1%
2005	6	70.6%
2005	7	72.4%
2005	8	71.4%
2005	9	69.2%
2005	10	49.6%
2005	11	56.2%
2005	12	54.5%
2006	1	52.7%
2006	2	CM
2006	3	CM
2006	4	CM
2006	5	CM
2006	6	CM

Sources: AUO Invoices Dataset, crystal\_prices\_products.xlsx

NOTES: NM - This month is designated a Crystal Meeting month based on Crystal Meetings Notes document GRNE0242661-DOJ(T) that said " which said "... let November price stay". This document cannot be used to accurately designate the share of November volume that was covered by price discussions. Percentage reported is percentage of AUO's sales of panels with diagonal screen size greater than 12". CM - Conspiracy Meeting month.

**Table 9****Crystal Meetings Participants' Percent of Volume from Crystal Meeting Products**

<b>Year</b>	<b>Month</b>	<b>Percent of Volume</b>
2001	10	76.6%
2001	11	87.7%
2001	12	89.4%
2002	1	91.7%
2002	2	89.3%
2002	3	88.7%
2002	4	90.3%
2002	5	87.3%
2002	6	87.7%
2002	7	86.8%
2002	8	86.2%
2002	9	CM
2002	10	CM
2002	11	NM
2002	12	83.2%
2003	1	82.2%
2003	2	82.5%
2003	3	83.1%
2003	4	83.1%
2003	5	86.3%
2003	6	85.3%
2003	7	83.9%
2003	8	85.2%
2003	9	84.4%
2003	10	82.9%
2003	11	88.7%
2003	12	56.2%
2004	1	87.5%
2004	2	90.6%
2004	3	89.2%
2004	4	85.3%
2004	5	91.7%
2004	6	91.3%
2004	7	91.1%
2004	8	83.9%
2004	9	82.9%
2004	10	83.0%
2004	11	CM
2004	12	71.0%
2005	1	68.7%
2005	2	CM
2005	3	68.9%
2005	4	64.1%

2005	5	78.1%
2005	6	79.6%
2005	7	82.2%
2005	8	79.4%
2005	9	78.5%
2005	10	56.5%
2005	11	63.2%
2005	12	53.2%
2006	1	54.9%
2006	2	CM
2006	3	CM
2006	4	CM
2006	5	CM
2006	6	CM

Sources: AUO, CMO, CPT, HannStar, LG, Samsung Invoices Datasets, crystal\_prices\_products.xlsx

NOTES: NM - This month is designated a Crystal Meeting month based on Crystal Meetings Notes document GRNE0242661-DOJ(T) that said " which said "... let November price stay". This document cannot be used to accurately designate the share of November volume that was covered by price discussions. Percentage reported is percentage of AUO's sales of panels with diagonal screen size greater than 12". CM - Conspiracy Meeting month.

**Table 10****Average Number of Competitors Selling Crystal Meeting Panels and Other Panels**

	<b>One Competitor</b>	<b>Two Competitors</b>	<b>Three Competitors</b>	<b>Four Competitors</b>	<b>Five Competitors</b>	<b>Six Competitors</b>
Crystal Meeting Panels	0.8%	3.0%	4.1%	7.6%	31.7%	52.9%
Other Panels	67.4%	16.7%	4.8%	4.8%	3.2%	3.0%

Sources: AUO, CMO, CPT, HannStar, LG, Samsung Invoices, crystal\_prices\_products.xlsx

NOTES: Crystal Meeting Panels and Other Panels shares are the average shares across the months in which there were Crystal Meeting prices. November 2002 is not included in the analysis because of the lack of information regarding Crystal Meeting panels compared to other panels, so the total number of months is 47. Only panels for which the monthly total sales were 1200 panels or more are included in the analysis.

**Table 11**

**Crystal Meetings Participants' Average Margin Per SQM of Products Sold**

<b>Period</b>	<b>Average Margin (M)</b>
Price Meetings	\$942
Conspiracy Meetings	\$478
Post Meetings Period	\$229

**Table 12****Regression Results - Overcharges in Dollars and in Percentages****Average Prices (6 Crystal Meetings Participants)**

	<b>Overcharge</b>	<b>Average Price</b>	<b>% Overcharge</b>	<b>Standard Error</b>
<b>All Products</b>	\$479	\$2,798	17.1%	260.44
<b>12.1"-30"</b>	\$439	\$2,787	15.8%	272.32
<b>14.1"</b>	\$453	\$2,892	15.7%	225.84
<b>15"</b>	\$477	\$2,688	17.7%	248.42
<b>17"</b>	\$312	\$2,774	11.3%	273.47

**AUO Prices**

	<b>Overcharge</b>	<b>Average Price</b>	<b>% Overcharge</b>	<b>Standard Error</b>
<b>All Products</b>	\$517	\$2,720	19.0%	224.89
<b>12.1"-30"</b>	\$523	\$2,715	19.3%	235.16
<b>14.1"</b>	\$355	\$2,696	13.2%	174.75
<b>15"</b>	\$404	\$2,633	15.3%	317.27
<b>17"</b>	\$587	\$2,766	21.2%	220.39

NOTES: Overcharge and Average Price are per SQM. Calculated across the 48 months of Price Meetings.

2001: Oct-Dec

2002: All less Sept and Oct

2003: All

2004: All less Nov

2005: All less Feb

2006: Jan

### **Chart 1**

Sources: AUO, CMO, CPT, HannStar, LG, Samsung Invoices Datasets

NOTES: Prices are indexed such that June 2006 = 100.

### **Chart 2**

Sources: Display Search Capacity Custom Database

NOTES: Display Search field "TFT Maker" is used to determine capacity by company except that Quanta capacity is not allocated to AUO until 2006 Q4 and Samsung capacity includes SMD capacity.

### **Chart 3**

Sources: Display Search Capacity Custom Database

NOTES: Display Search field "TFT Maker" is used to determine capacity by company except that Quanta capacity is not allocated to AUO until 2006 Q4 and Samsung capacity includes SMD capacity.

### **Chart 4**

Sources: Display Search Quarterly Large-Area TFT LCD Shipment Report, various issues

### **Charts 5**

Sources: AUO, CMO, CPT, HannStar, LG, Samsung Invoices Datasets, crystal\_prices\_products.xlsx

### **Charts 6**

Sources: AUO, CMO, CPT, HannStar, LG, Samsung Invoices Datasets

### **Charts 7**

Sources: AUO Invoices Dataset

NOTES: All transactions with positive revenue and more than a single unit are plotted. For legibility, upper range limits for some months are not shown. For Chart 7A, the maximum price in 2003.01 is \$361 and that in 2007.07 is \$1127. For Chart 7B, the maximum price in 2002.09 is \$683. For Chart 7C, the maximum price in 2004.02 is \$11590 and that in 2004.09 is \$9206.

### **Charts 10**

Sources: AUO, CMO, CPT, HannStar, LG, Samsung Invoices, crystal\_prices\_products.xlsx

NOTES: Prices are indexed such that January 2004 = 100

### **Chart 11**

Sources: AUO invoice database, crystal\_prices\_products.xlsx

### **Chart 12**

Sources: AUO, CMO, CPT, HannStar, LG, and Samsung Invoices. Cash Cost Documents, Table 6

NOTES: Margin is Area Price less Area Cash Cost.

### **Charts 13**

Sources: AUO, CMO, CPT, HannStar, LG, Samsung Invoices Datasets

NOTES: Panel sizes with fewer than 1000 unit sales are not included.



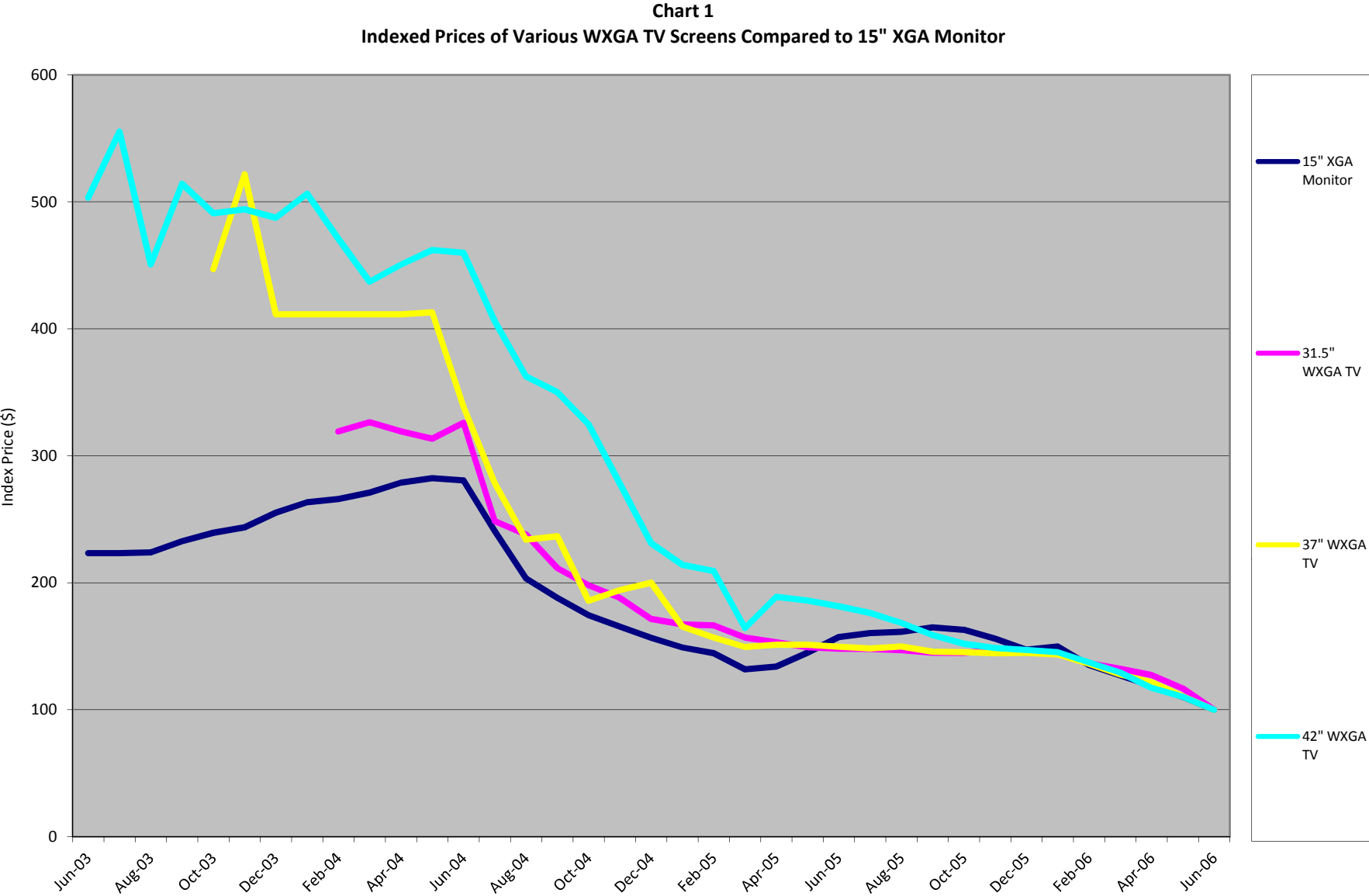
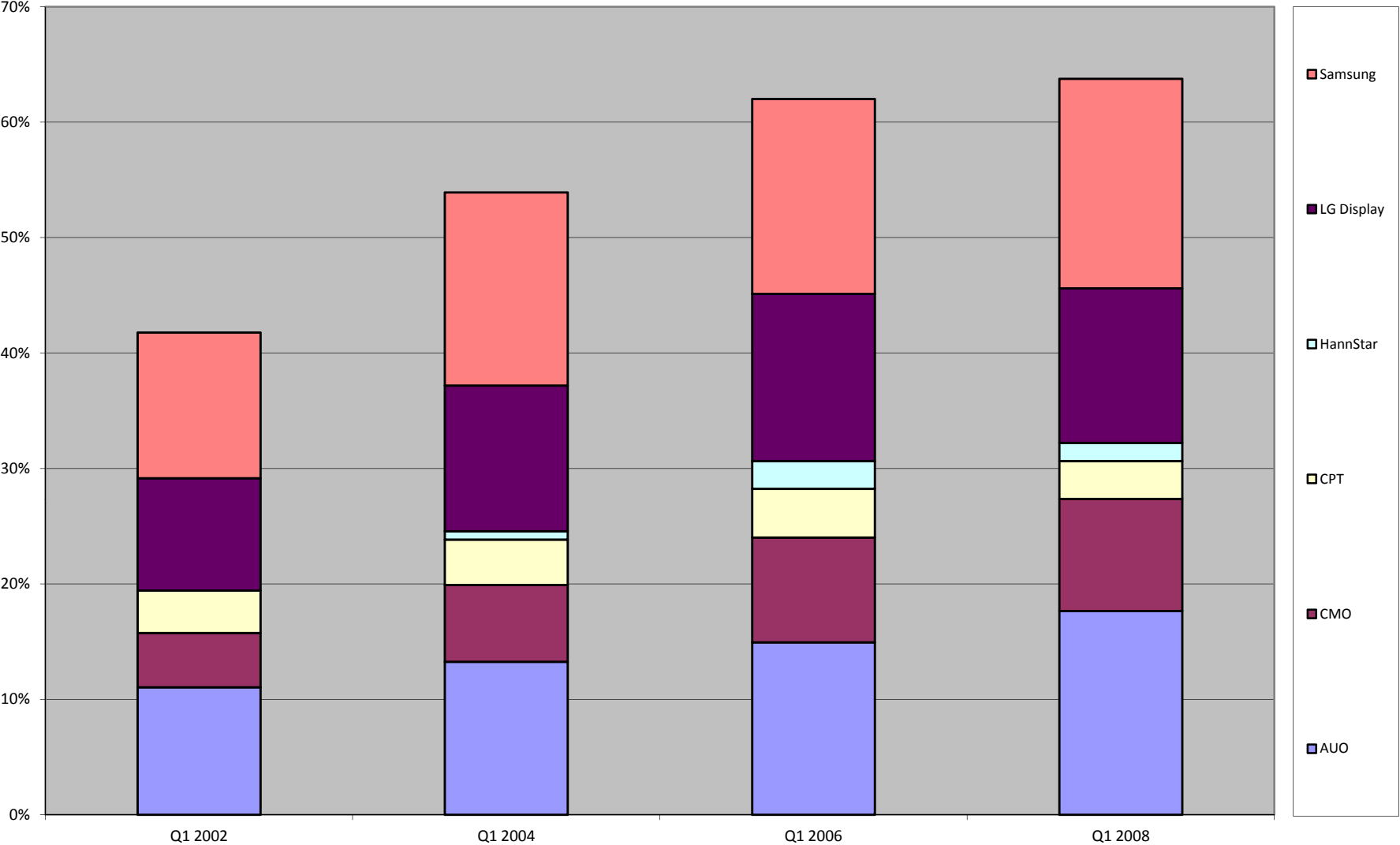
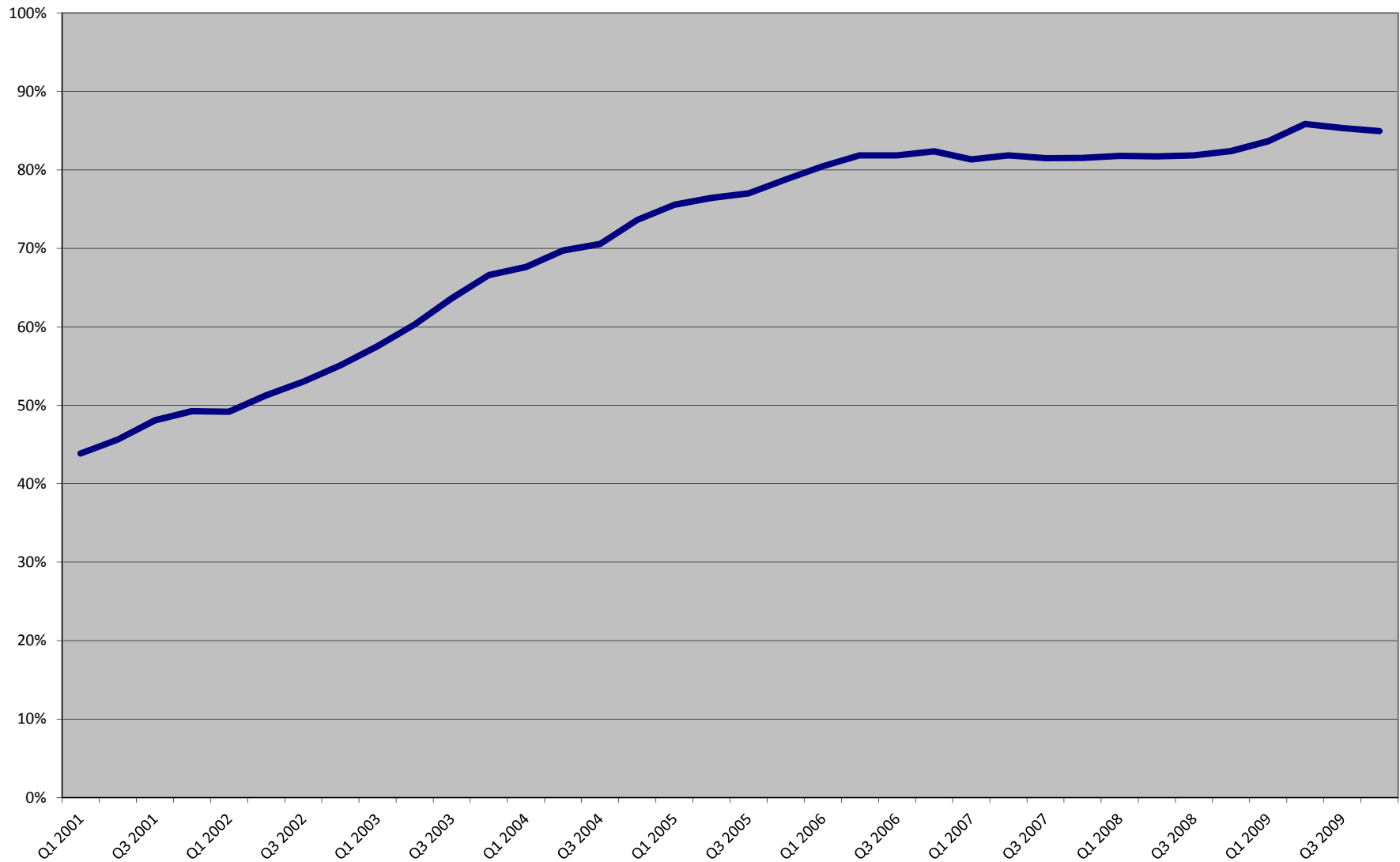


Chart 2  
Capacity Shares of 6 Crystal Meetings Participants



**Chart 3**  
**Combined Capacity Share of the 6 Crystal Meetings Participants for all LCD Panels**



**Chart 4**  
**Combined Capacity Share of the 6 Crystal Meetings Participants for 12"+ LCD Panels**

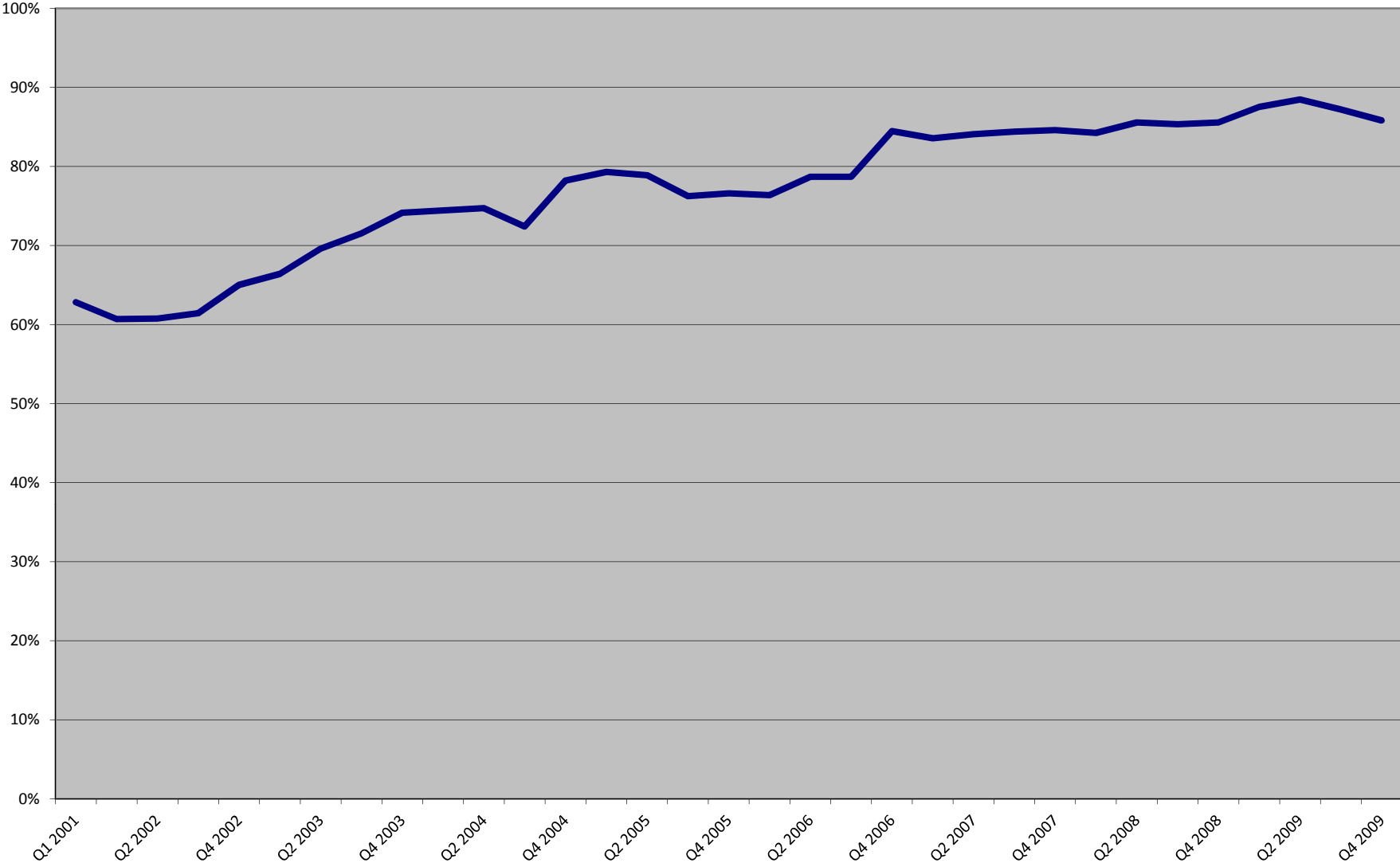


Chart 5A  
Crystal Meeting Prices and Average Transactions Prices for 14.1" XGA Notebook Panel

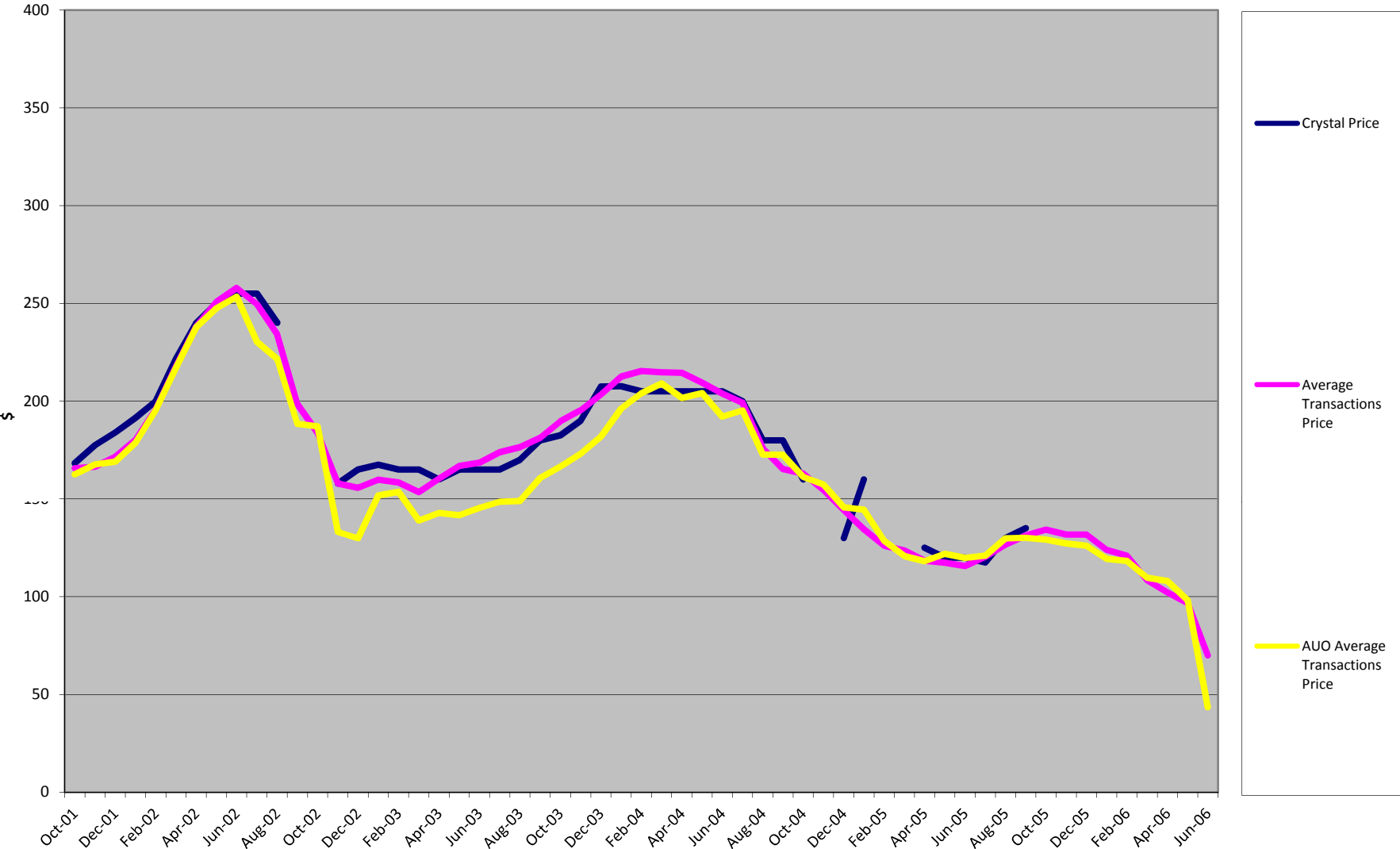


Chart 5B  
Crystal Meeting Prices and Average Transactions Prices for 15" XGA Monitor Panel

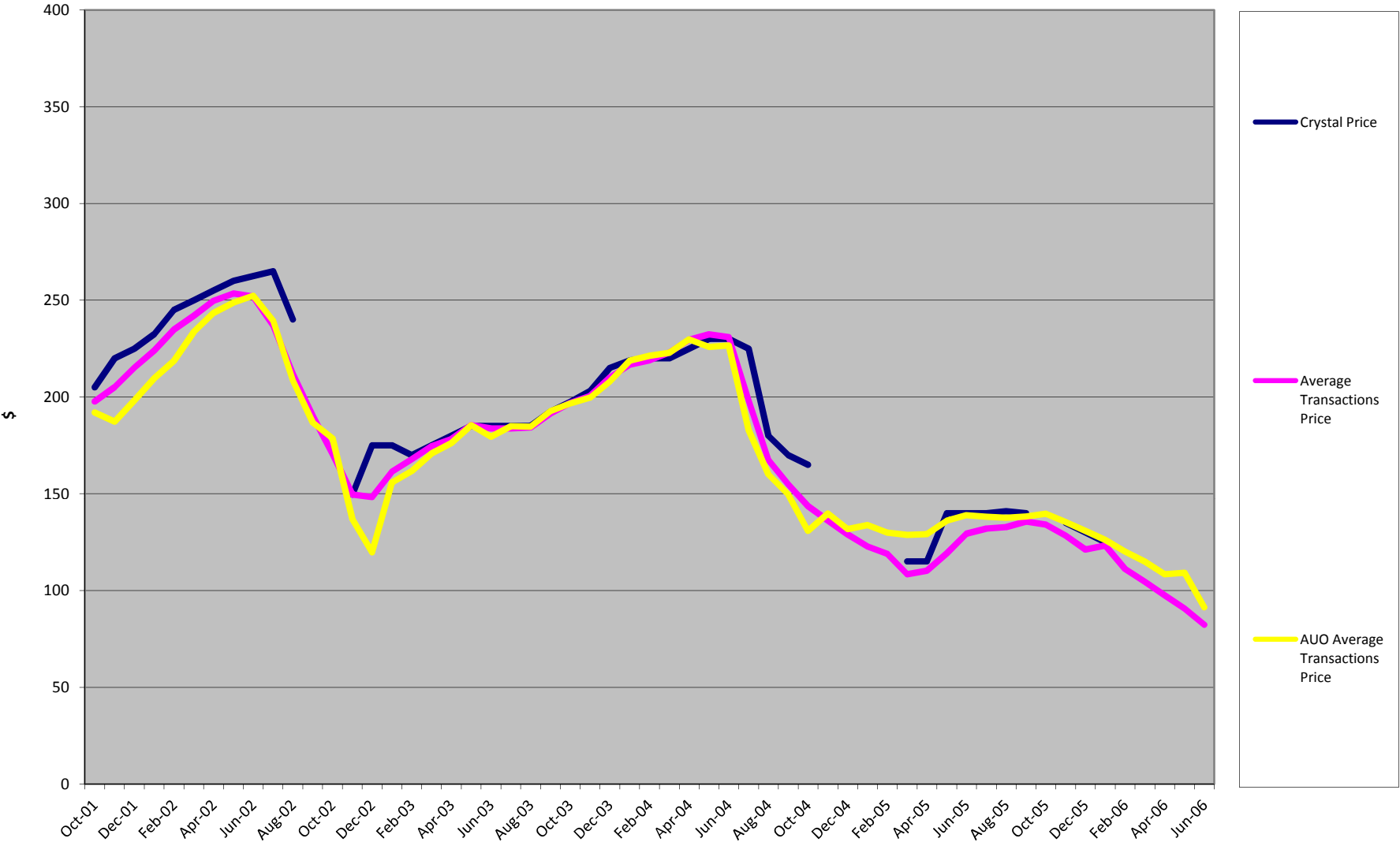


Chart 5C  
Crystal Meeting Prices and Average Transactions Prices for 15" XGA Notebook Panel

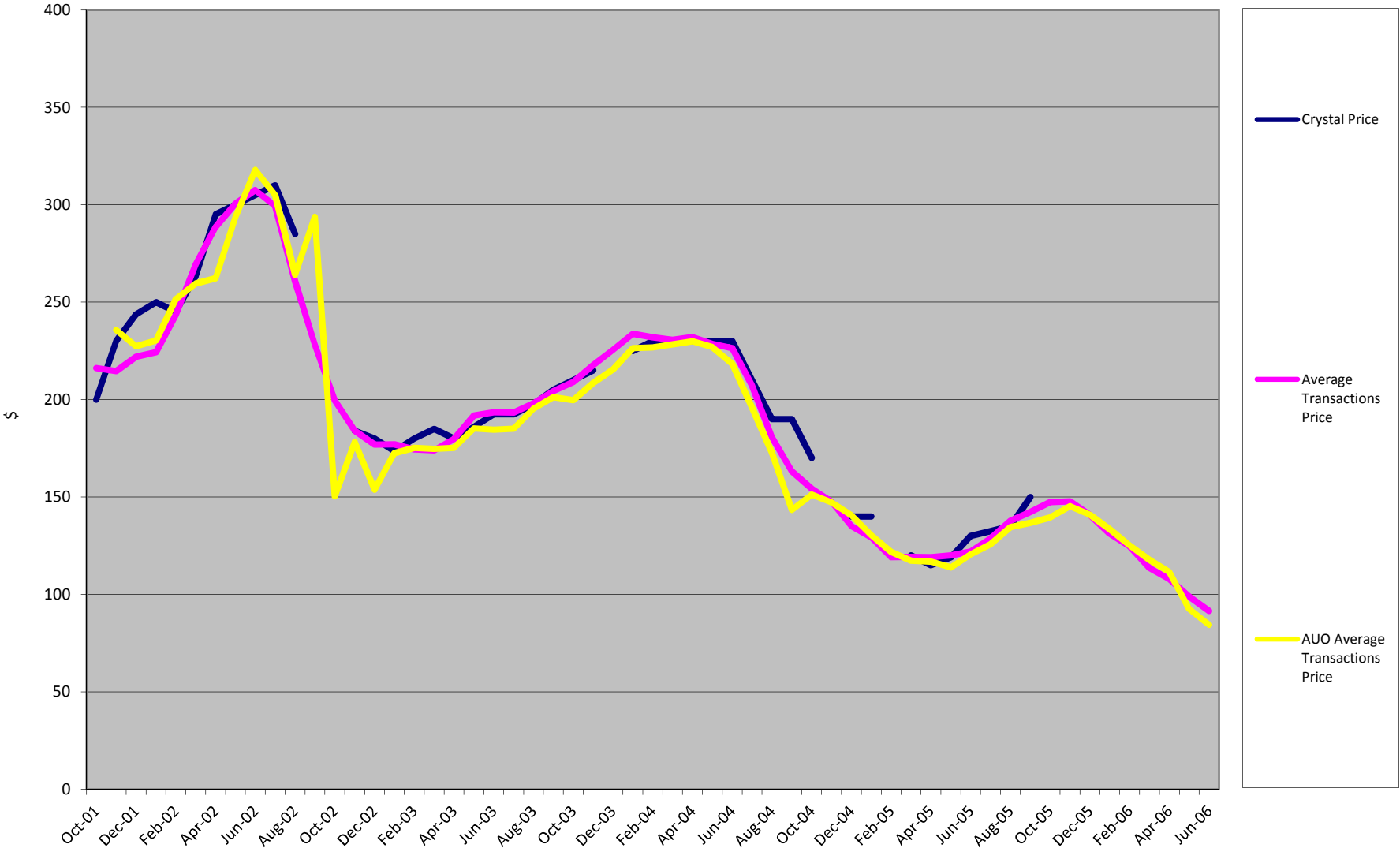


Chart 5D  
Crystal Meeting Prices and Average Transactions Prices for 17" SXGA Monitor Panel

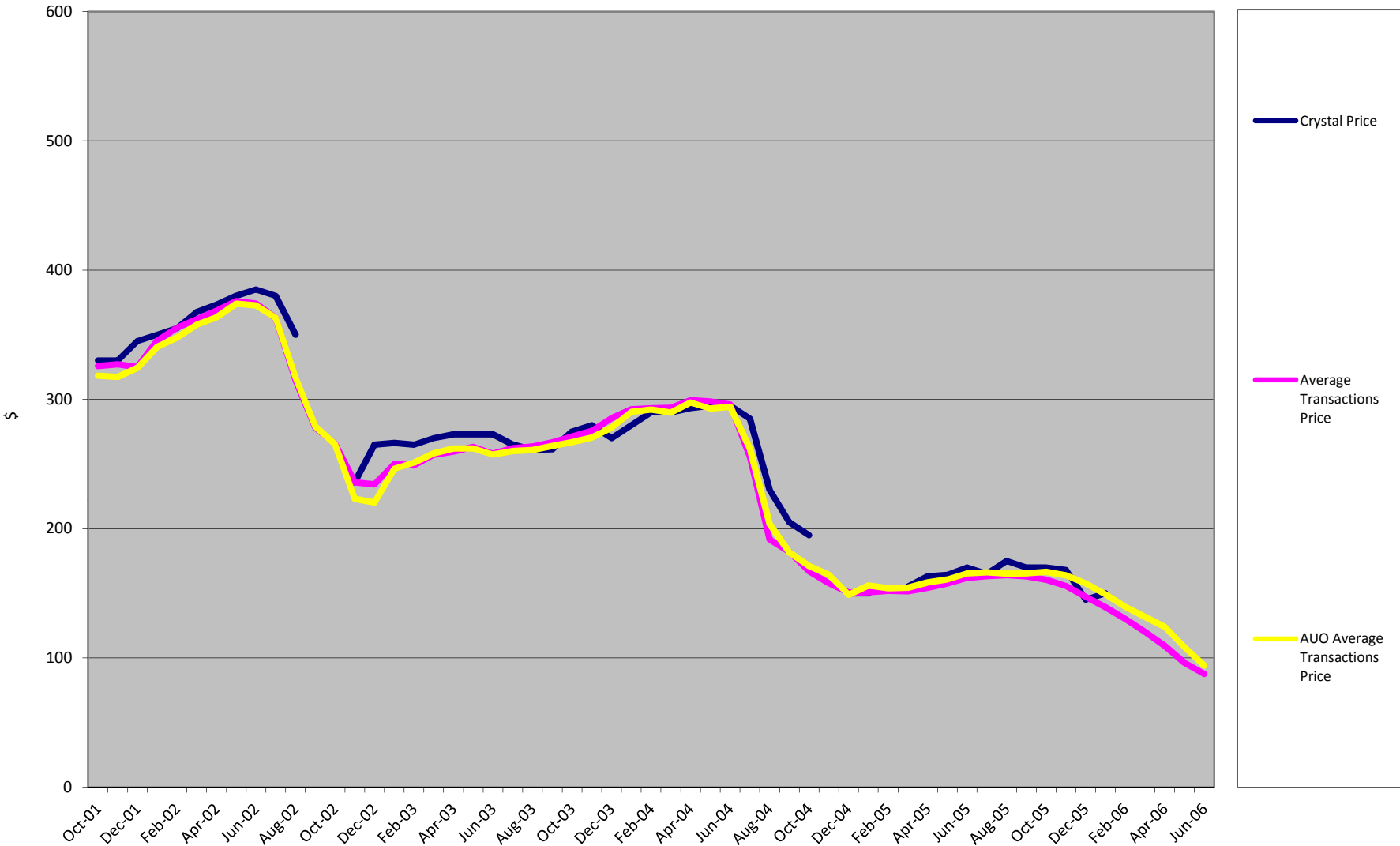
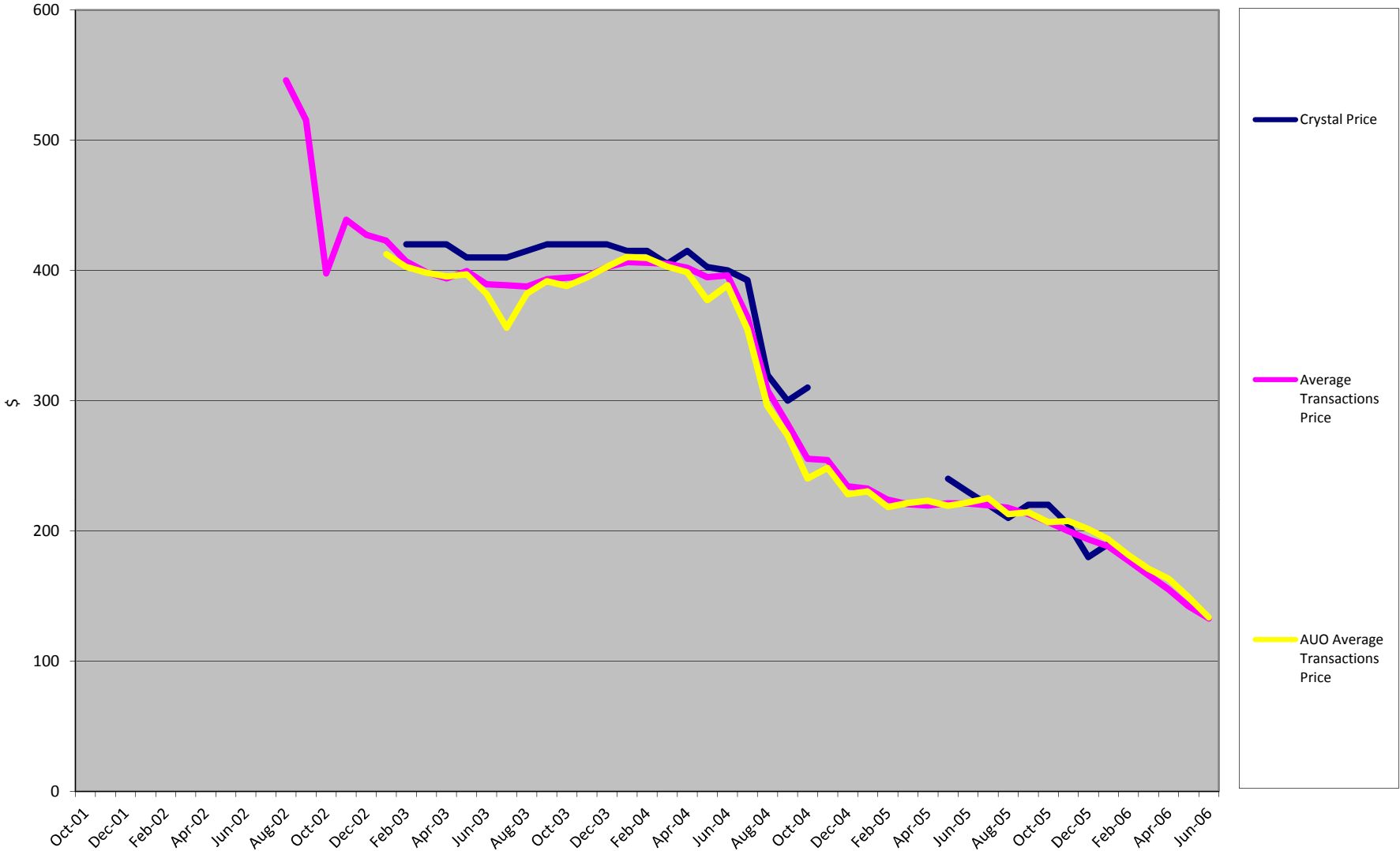




Chart 5E  
Crystal Meeting Prices and Average Transactions Prices for 19" SXGA Monitor Panel



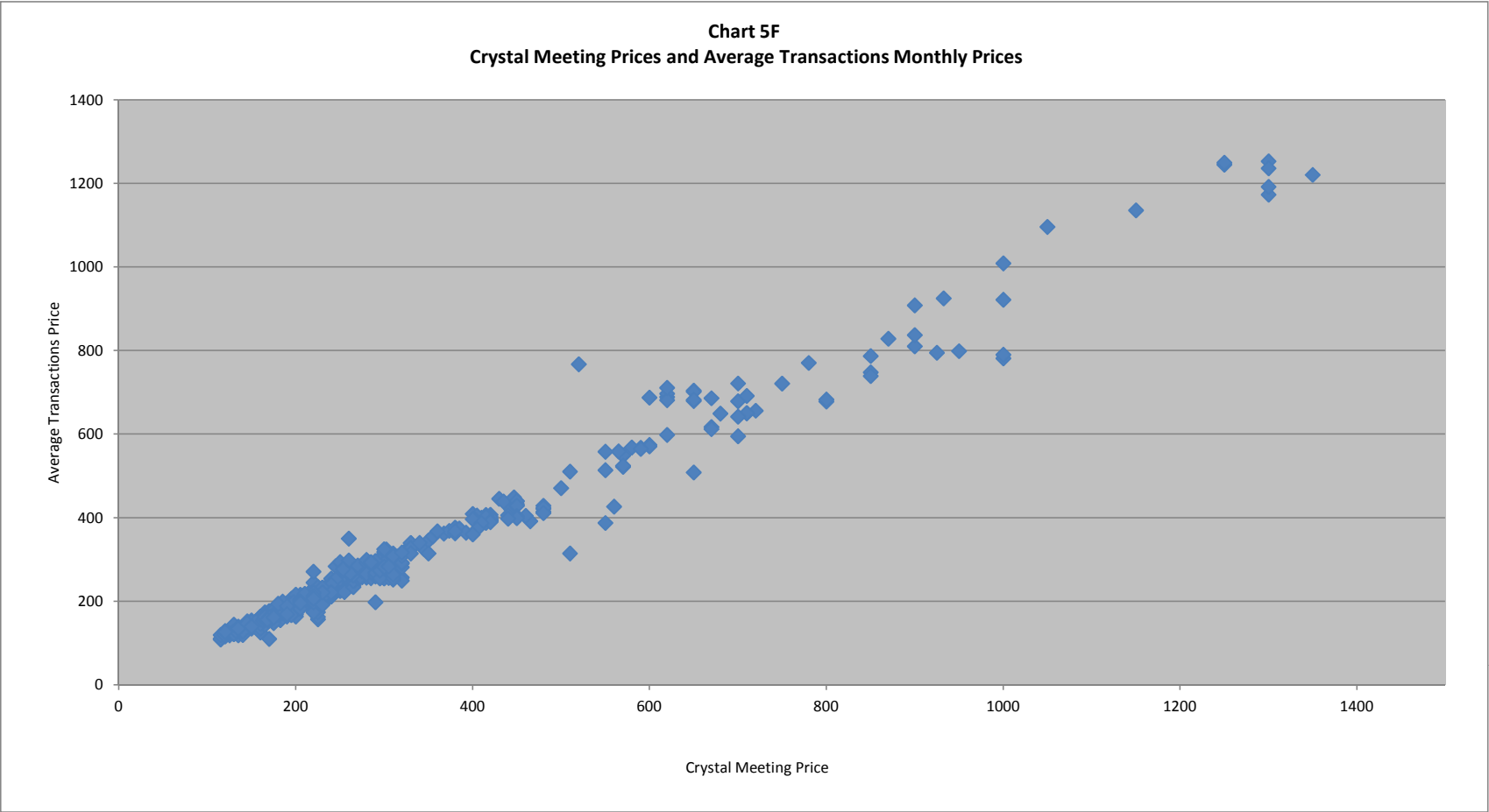


Chart 6A  
Average Transaction Price for 14.1" XGA Notebook Panels

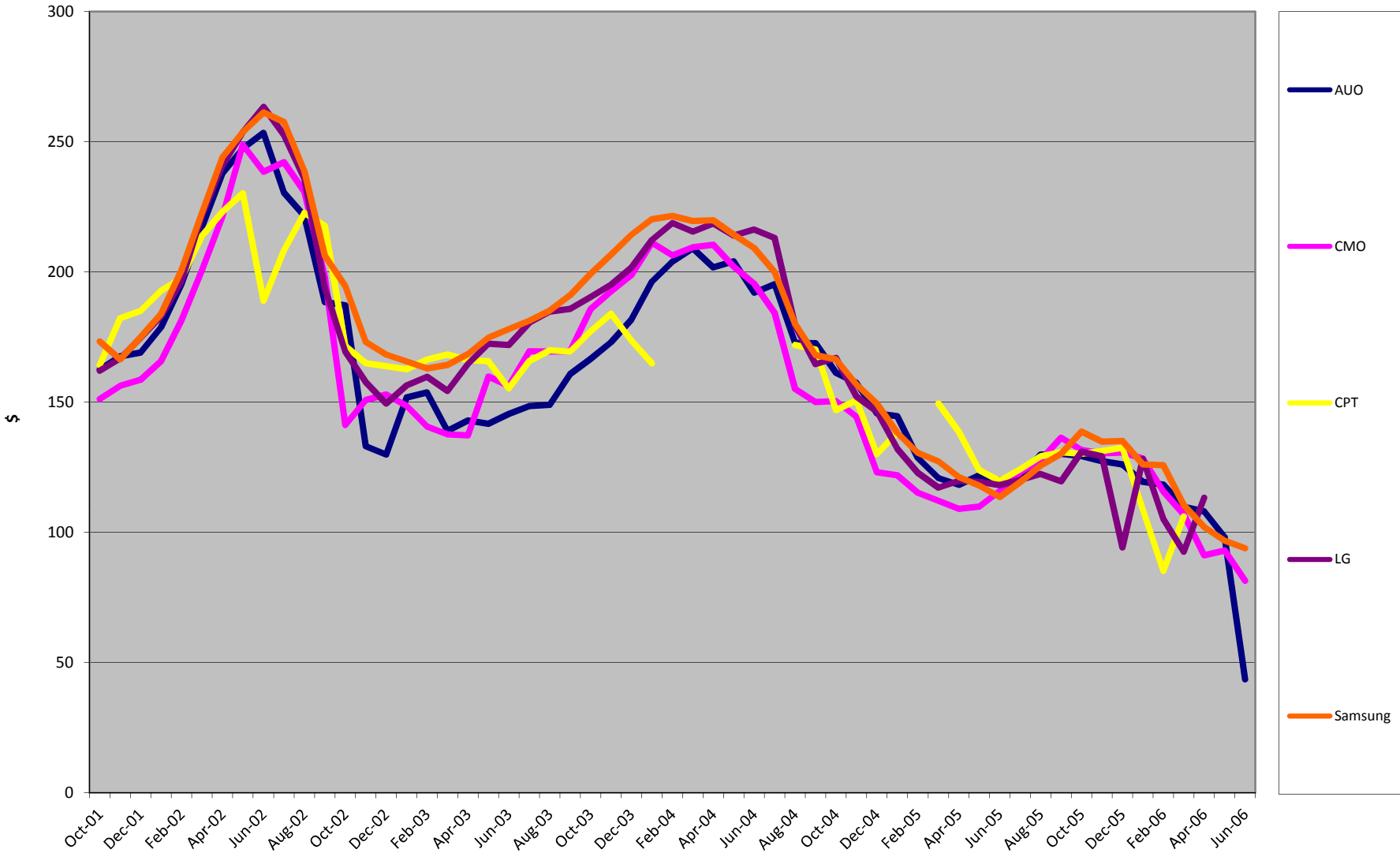


Chart 6B  
Average Transaction Price for 15" XGA Monitor Panels

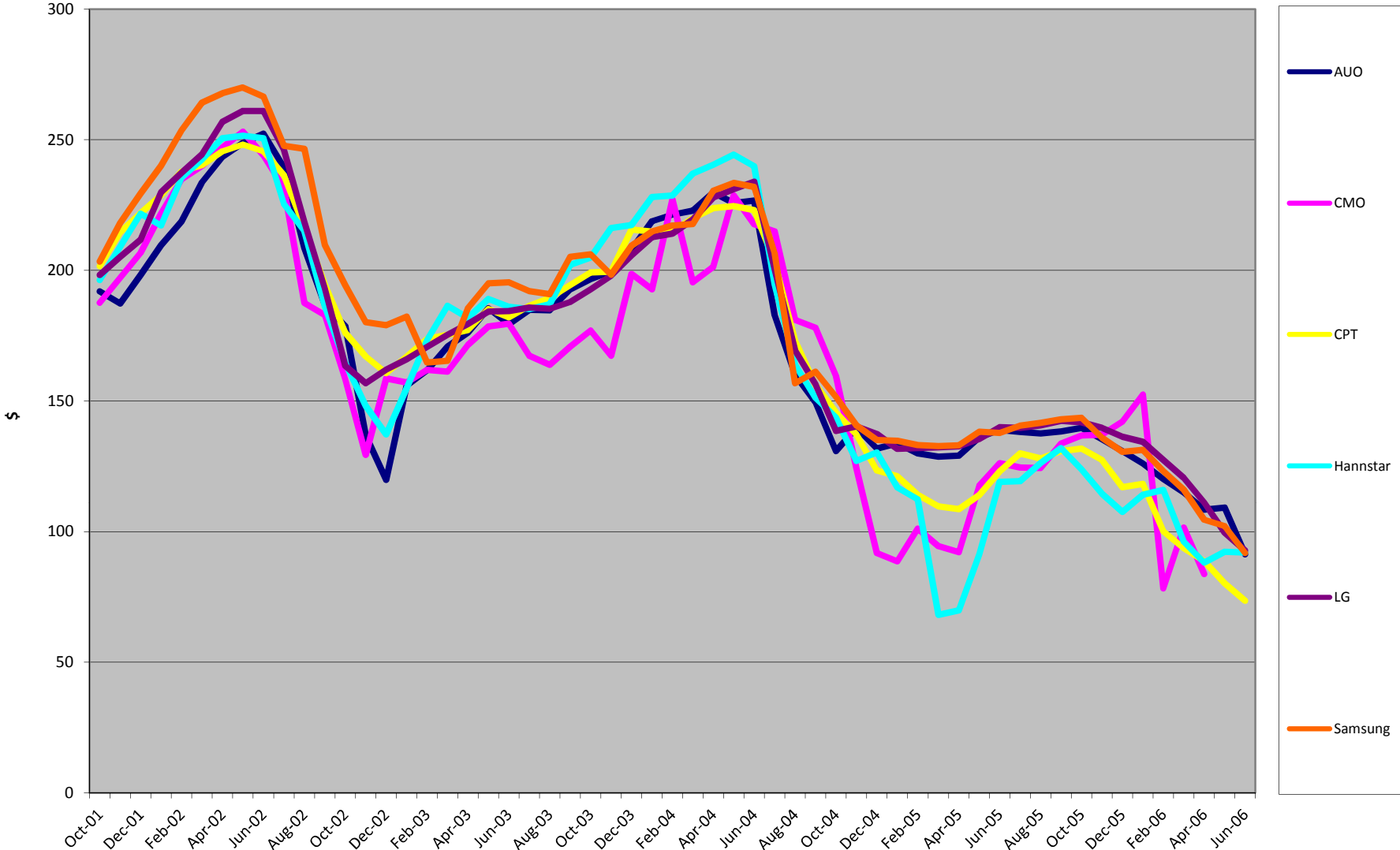


Chart 6C  
Average Transaction Price for 15" XGA Notebook Panels

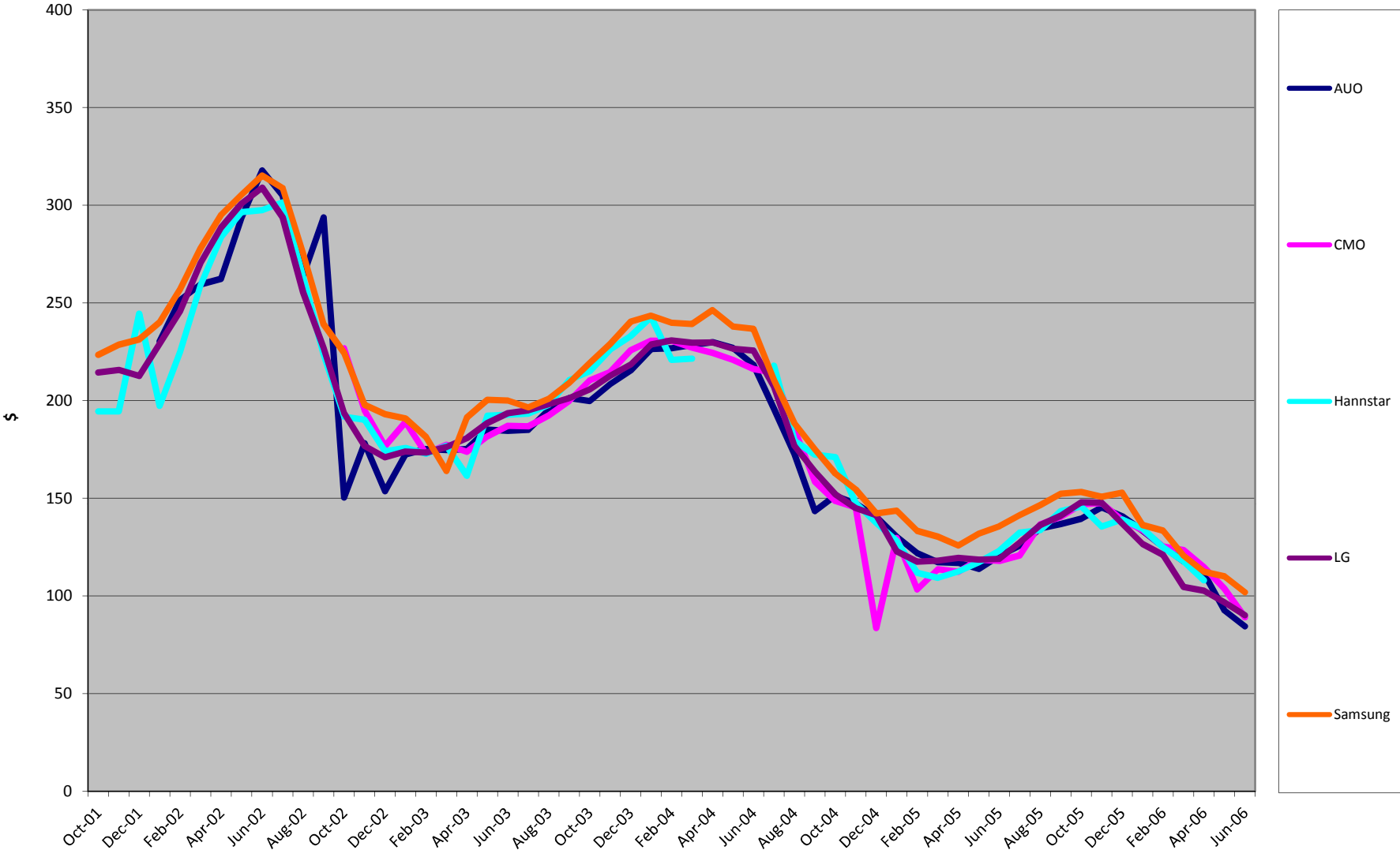


Chart 6D  
Average Transaction Price for 17" SXGA Monitor Panels

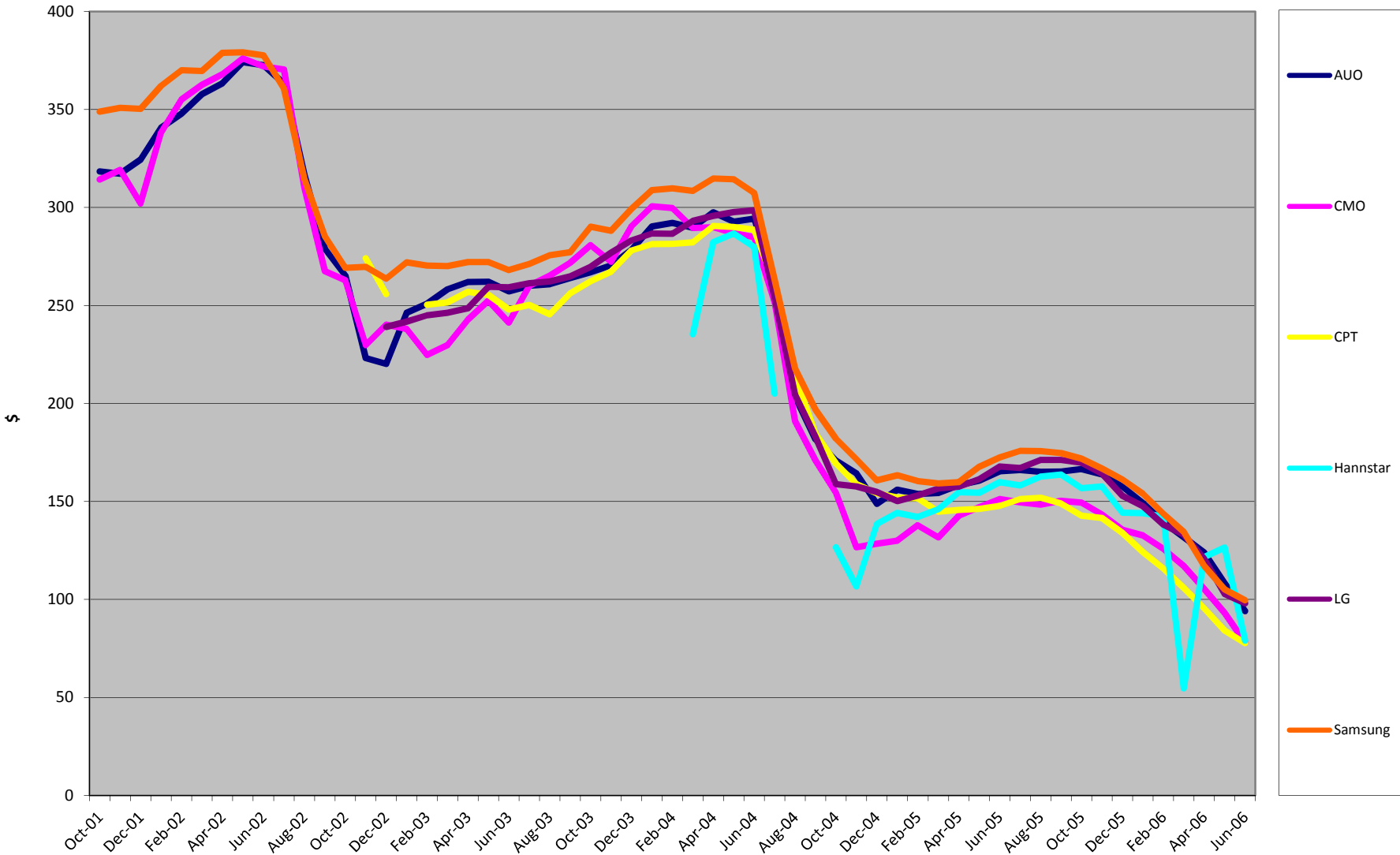
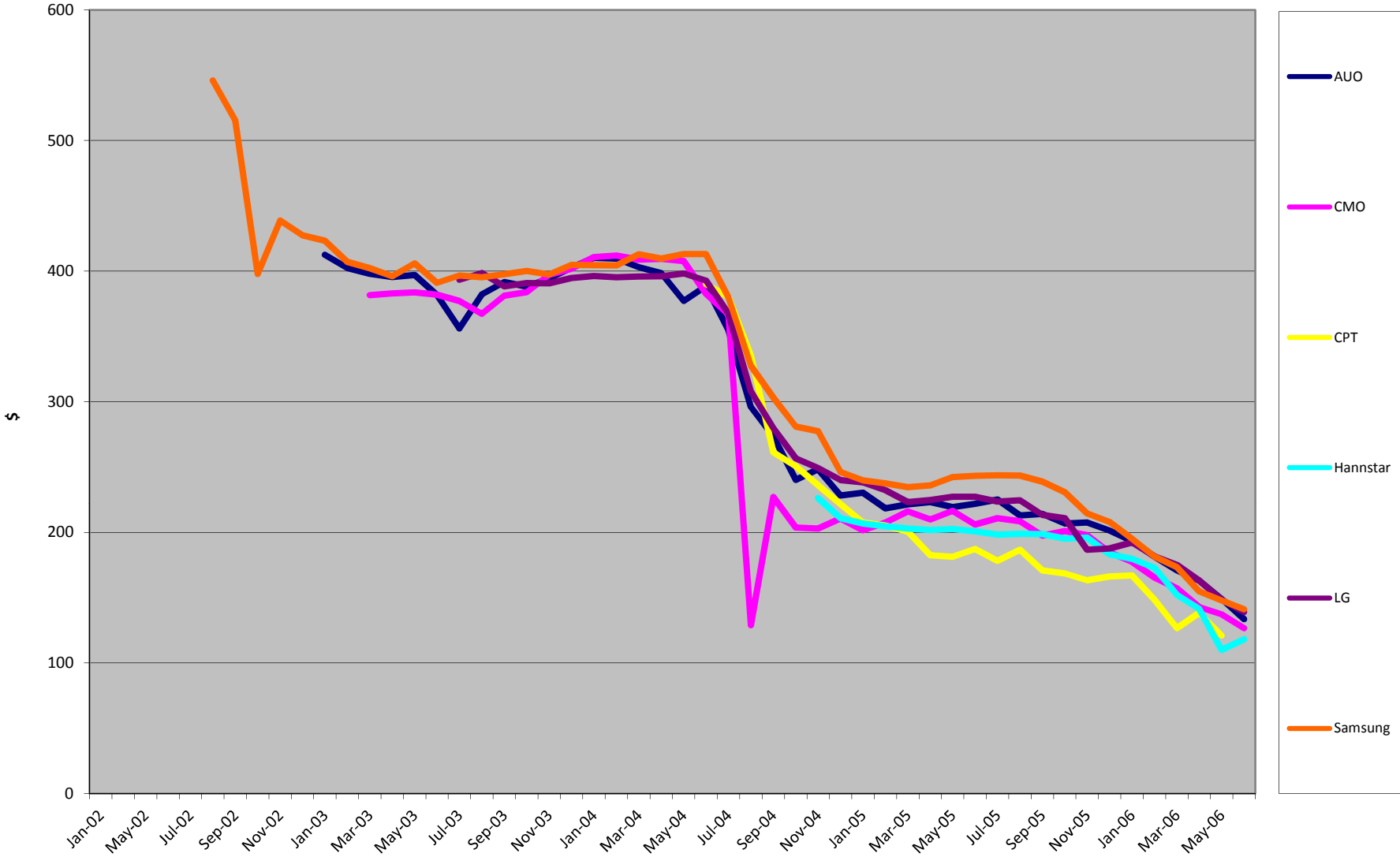


Chart 6E  
Average Transaction Price for 19" SXGA Monitor Panels



# Charts 7A-C

## Monthly Price Dispersions of AUO Transaction Prices

Chart 7A – 15in XGA Monitor

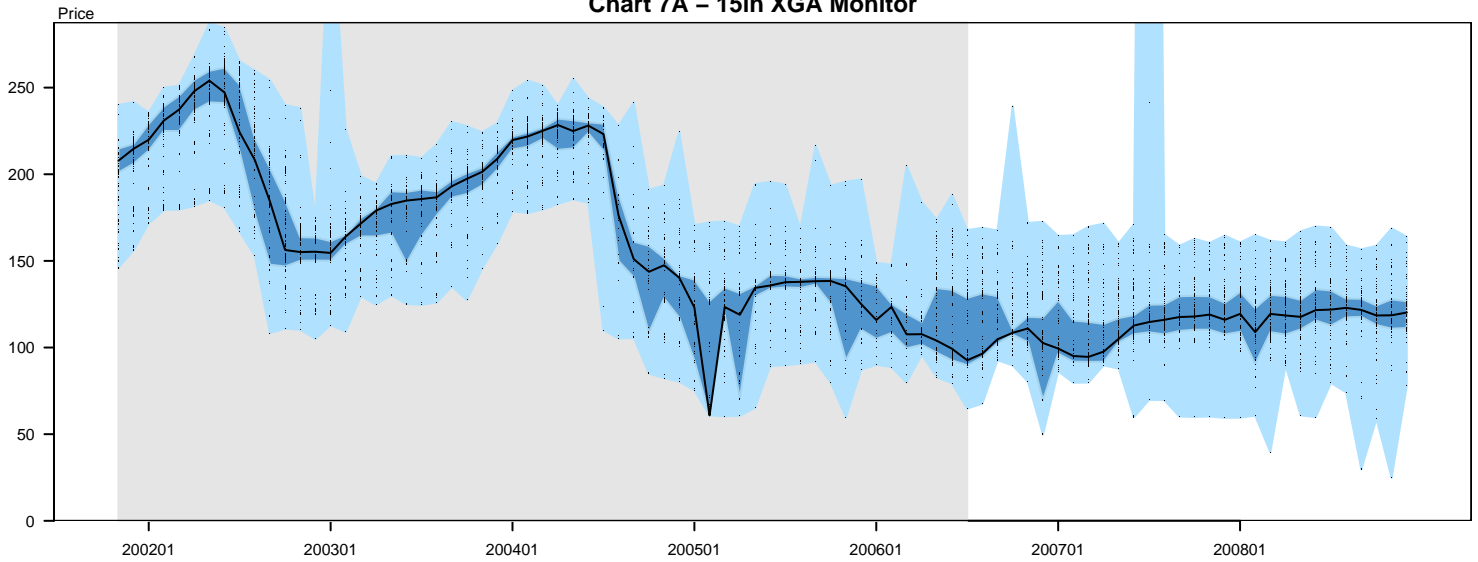


Chart 7B – 17in SXGA Monitor

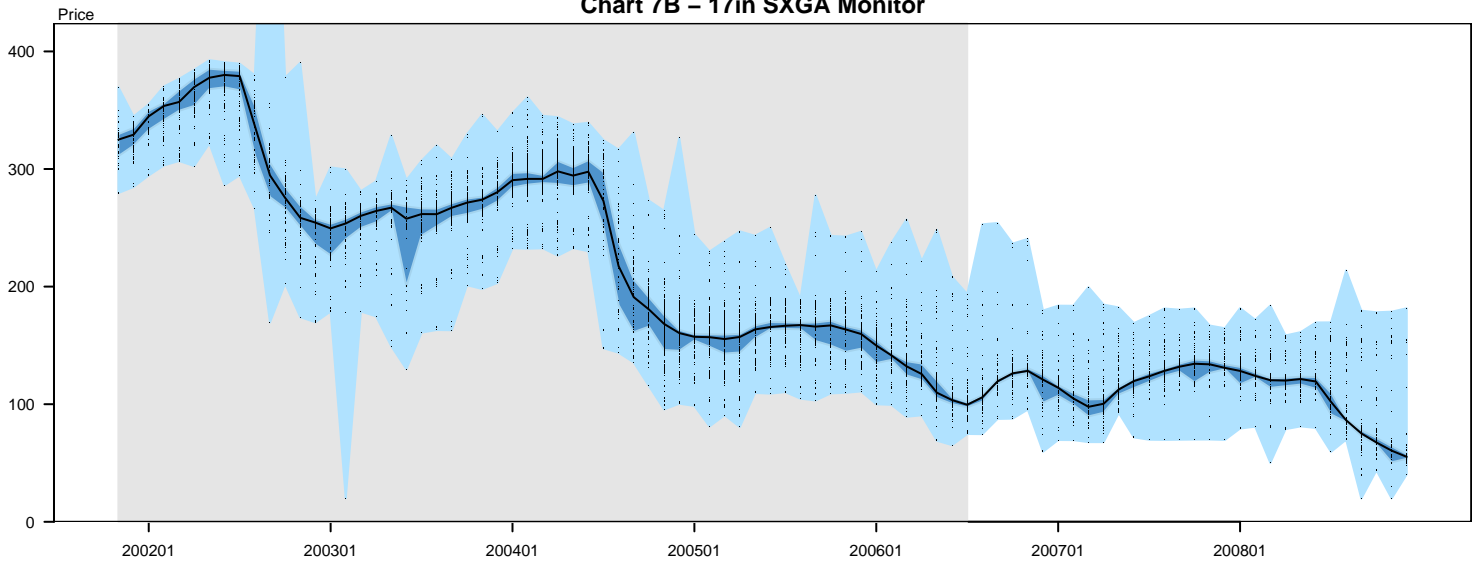


Chart 7C – 19in SXGA Monitor

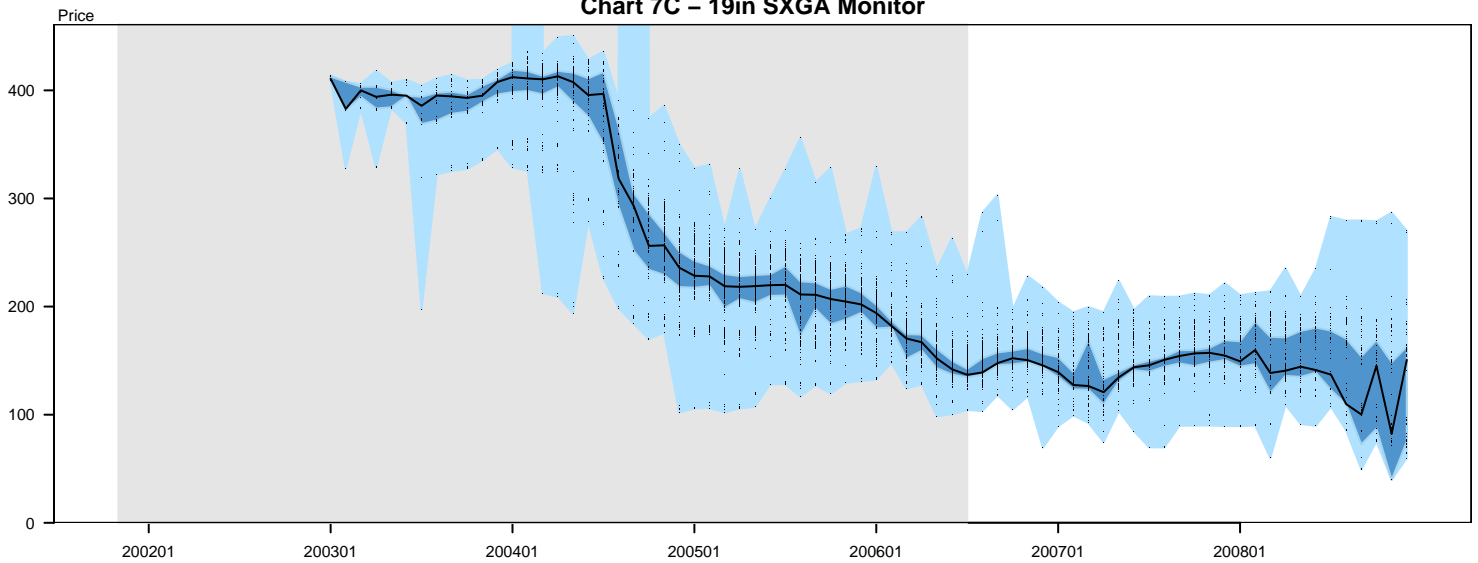
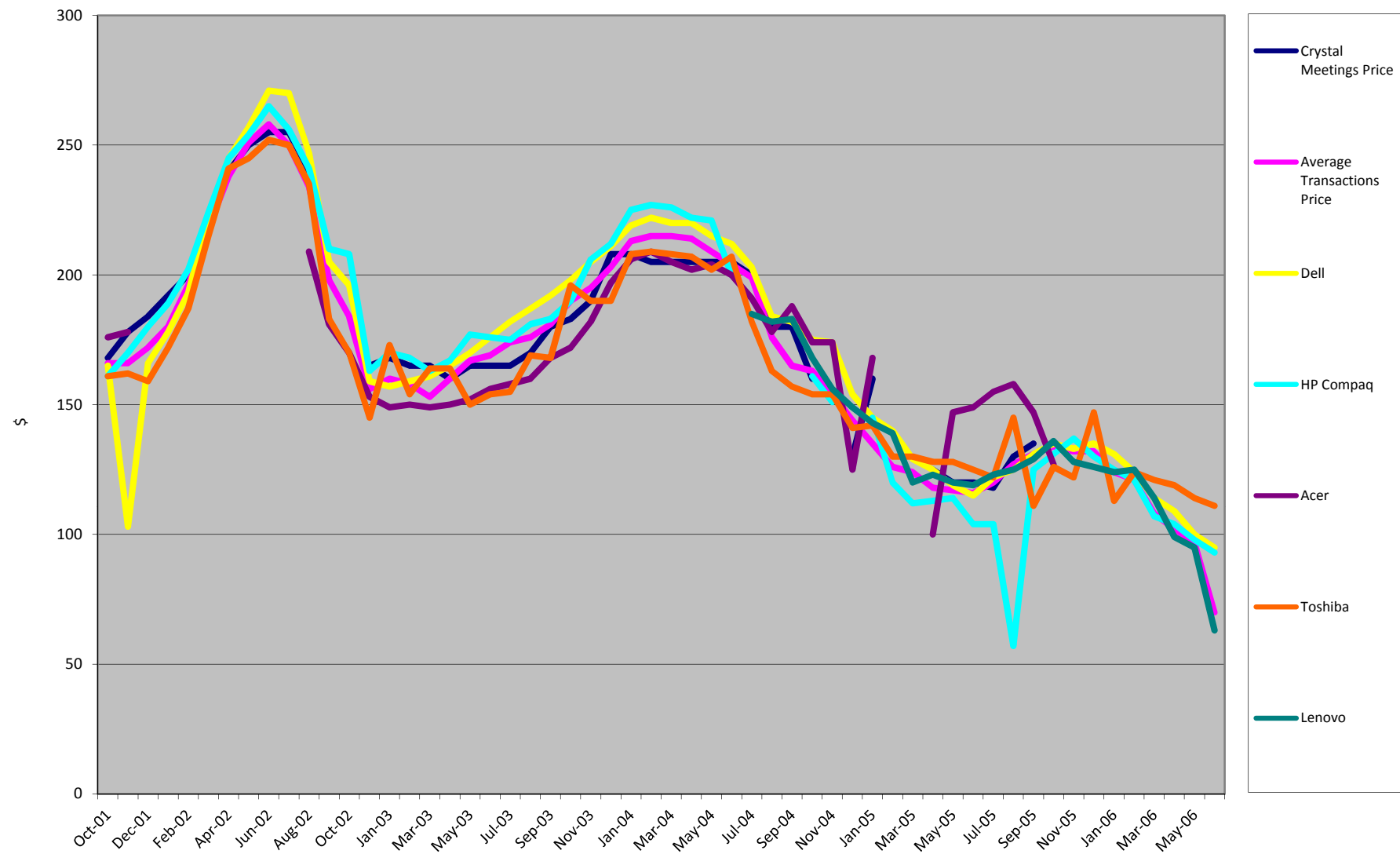




Chart 8A  
Average Prices Paid for 14.1" XGA Notebook Panels



**Chart 8B**  
**Average Prices Paid for 15" XGA Monitor Panels**

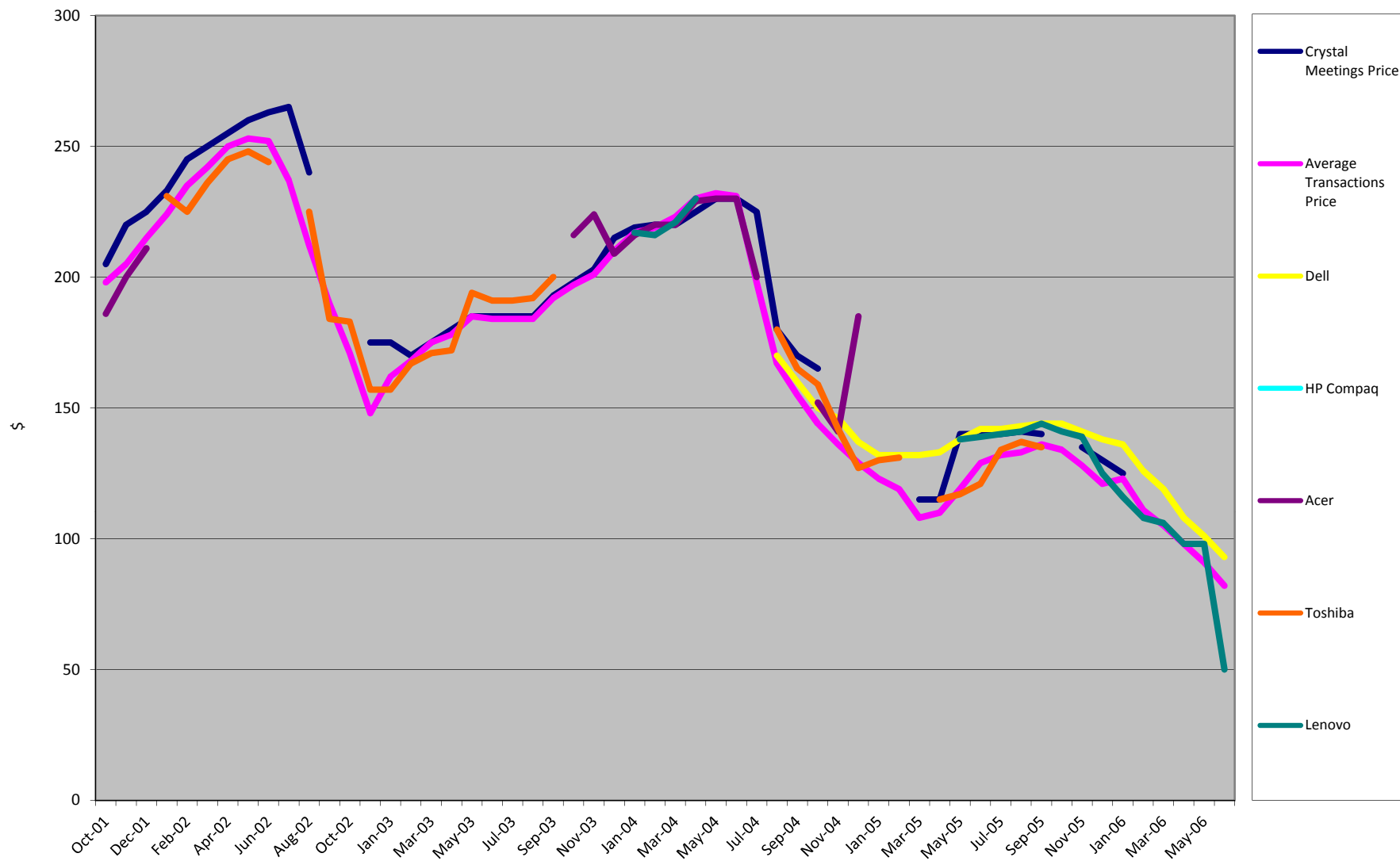


Chart 8C  
Average Prices Paid for 15" XGA Notebook Panels

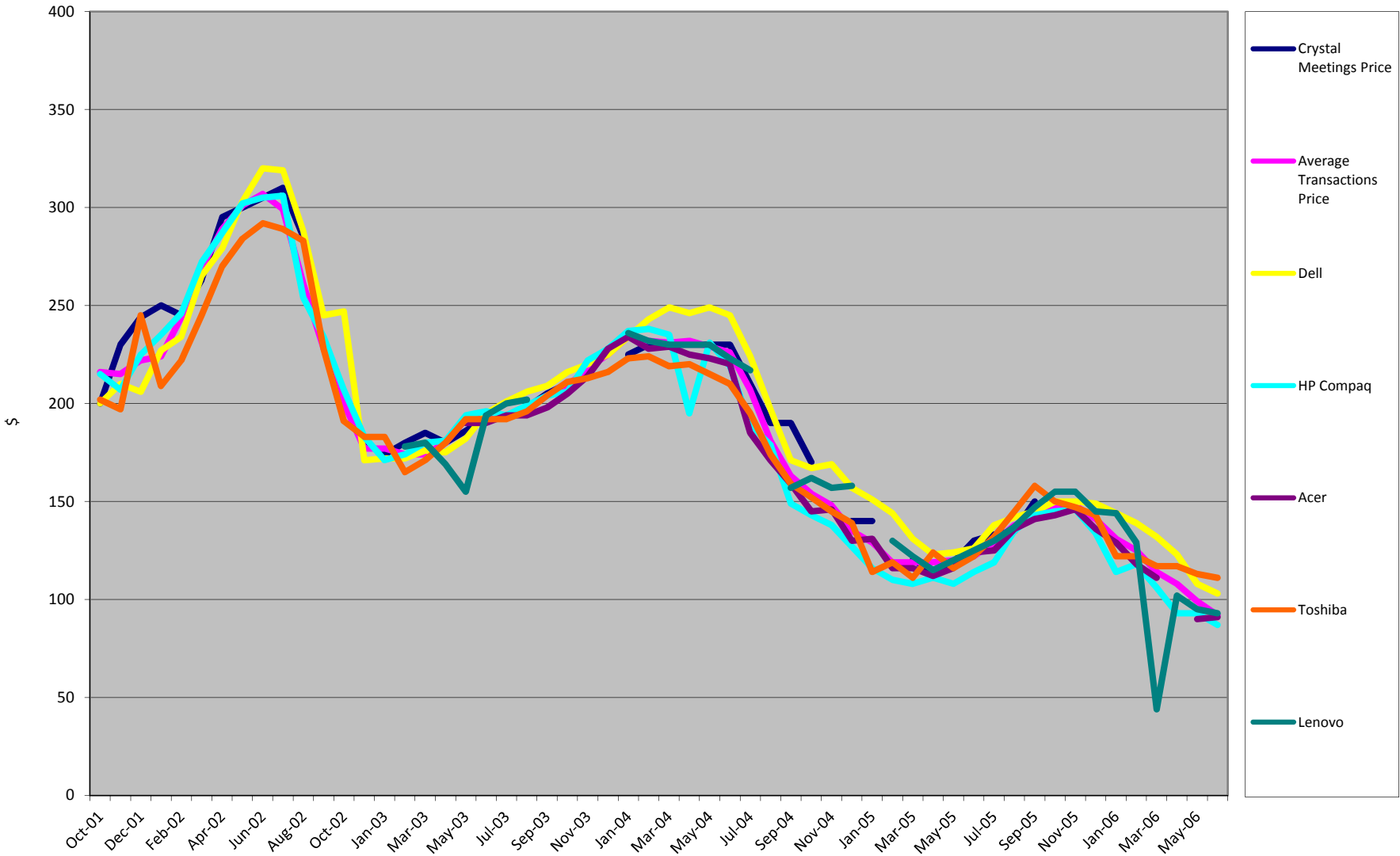


Chart 8D  
Average Prices Paid for 17" SXGA Monitor Panels

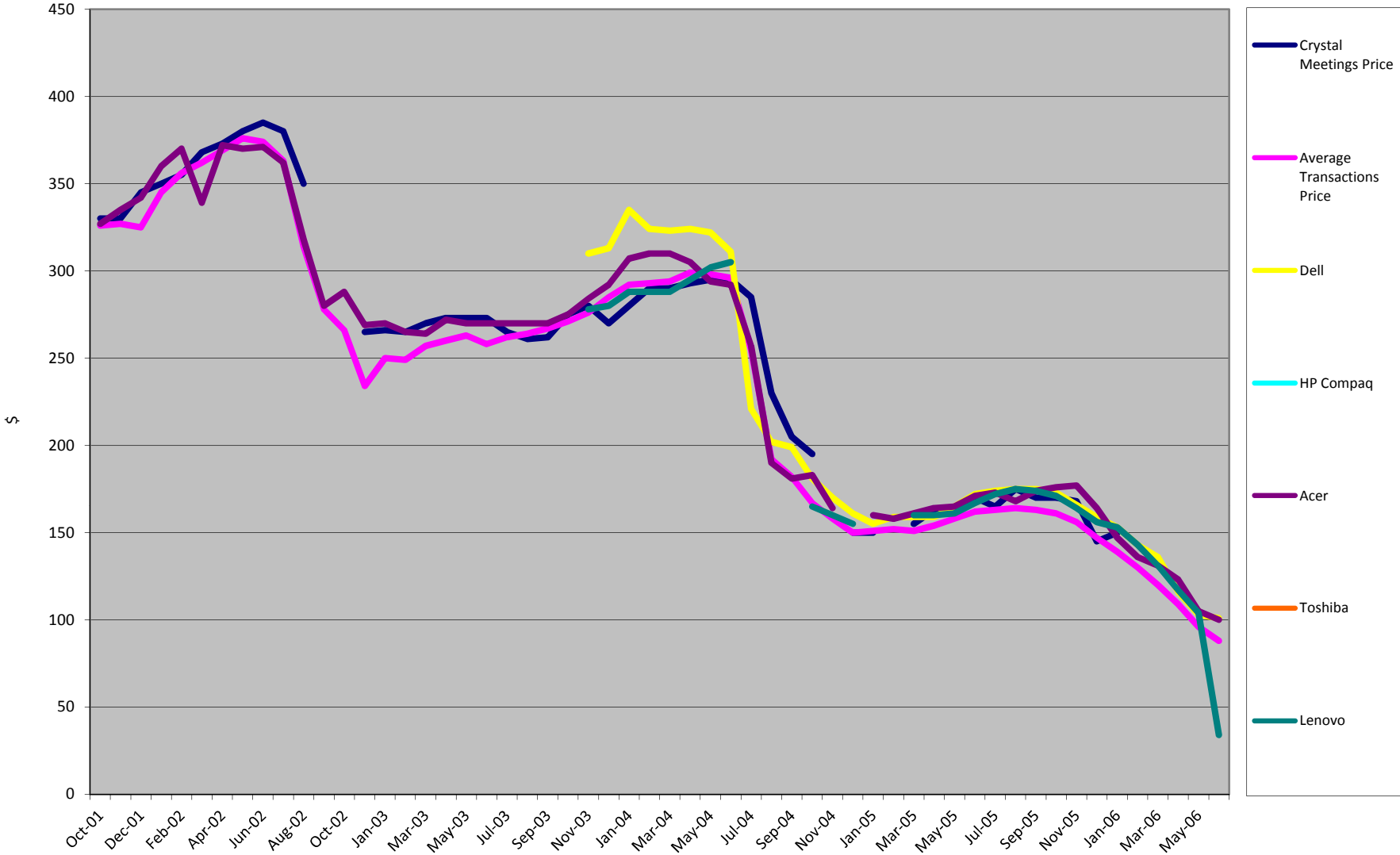


Chart 8E  
Average Prices Paid for 19" SXGA Monitor Panels

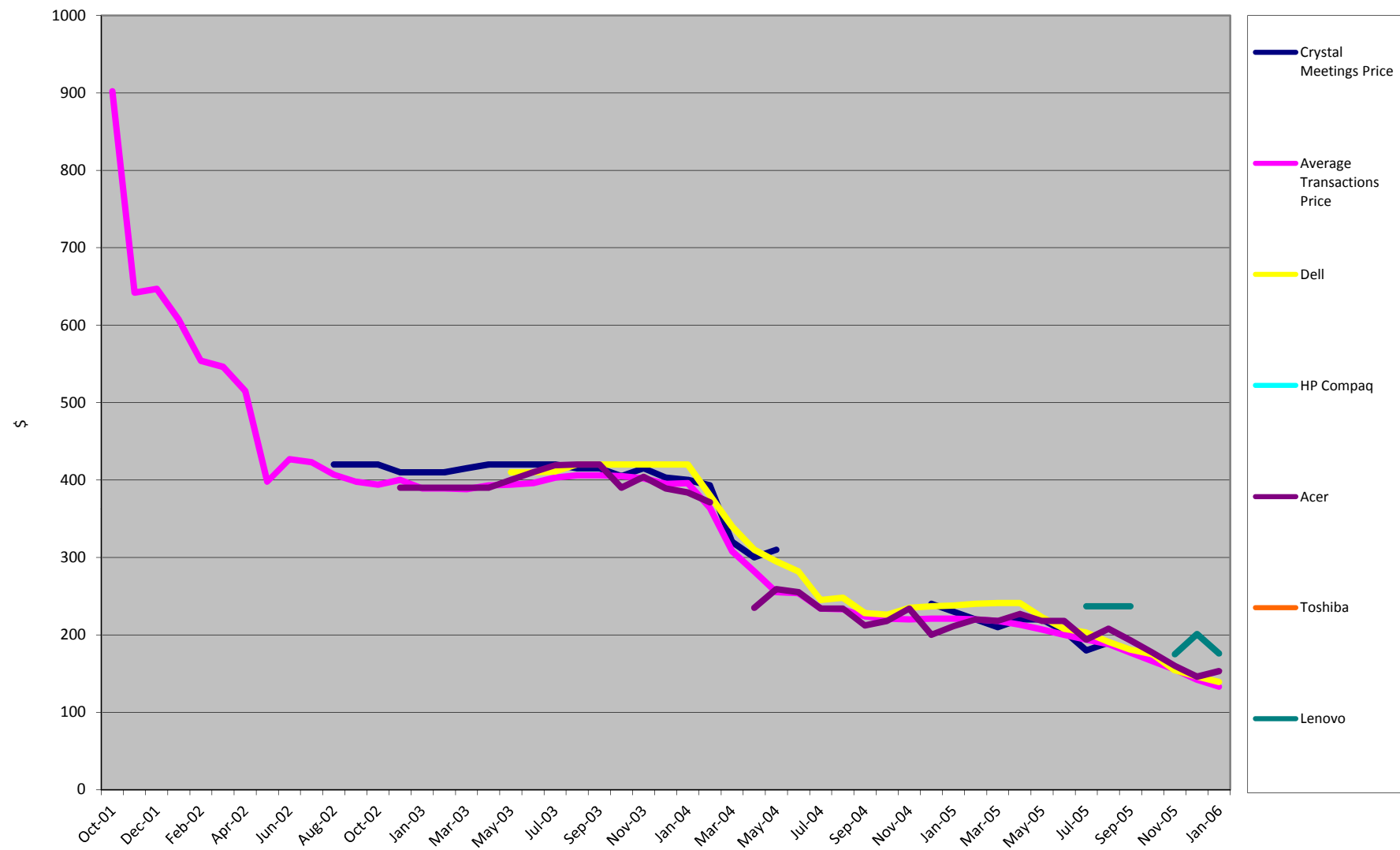


Chart 9A  
First Differences in Prices of 14.1" XGA Notebook Panels

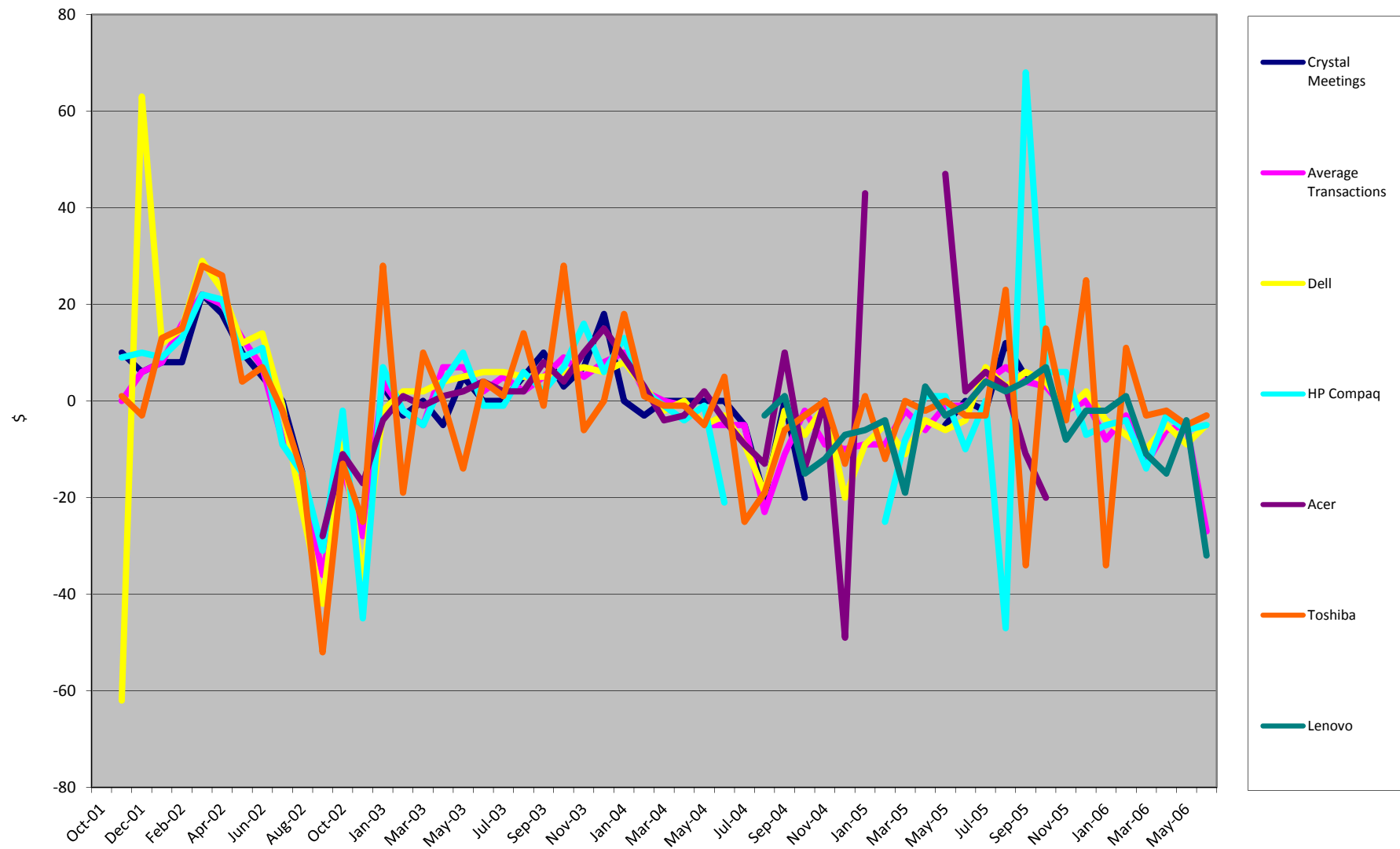


Chart 9B  
First Differences in Prices of 15" XGA Monitor Panels

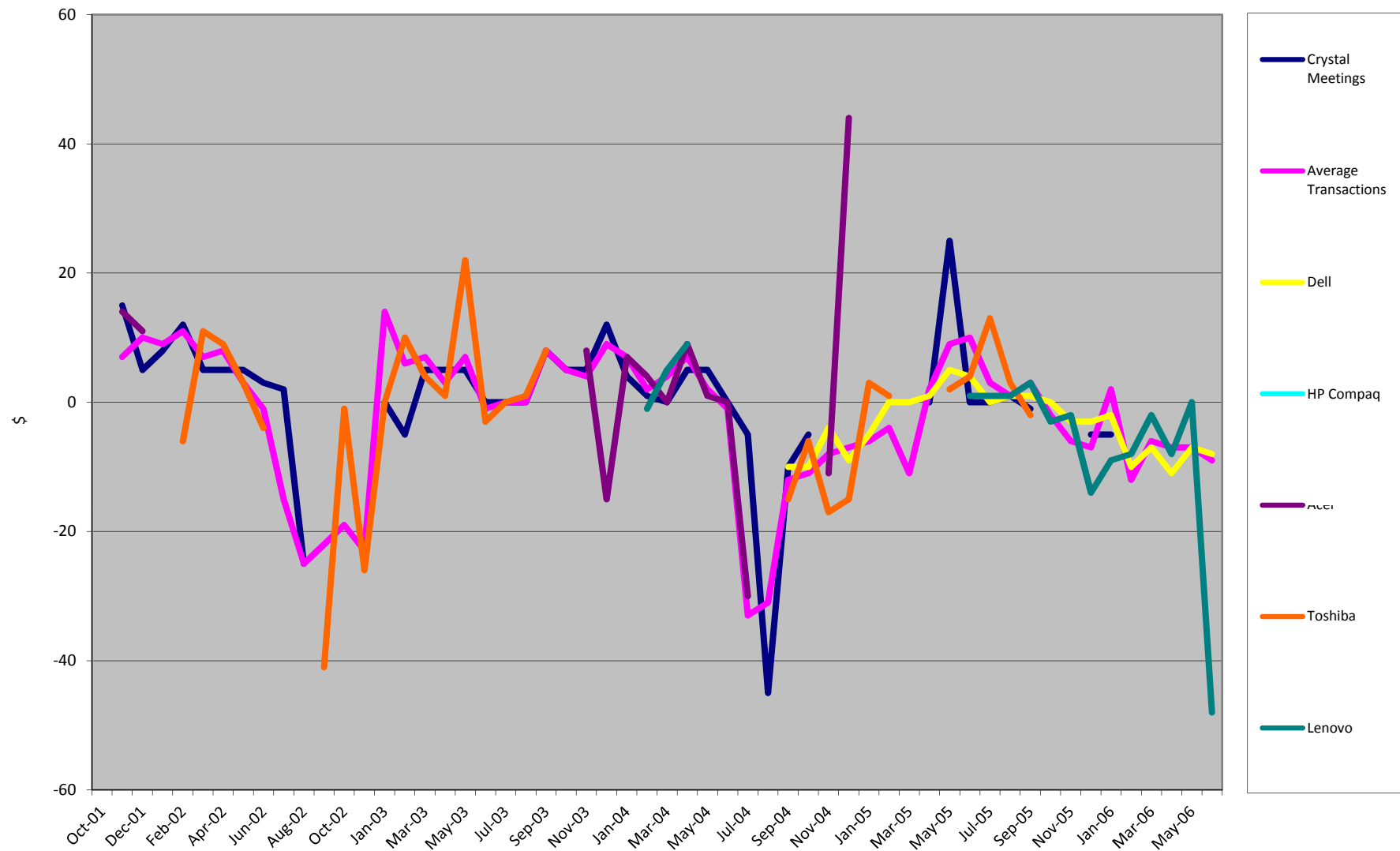


Chart 9C  
First Differences in Prices of 15" XGA Notebook Panels

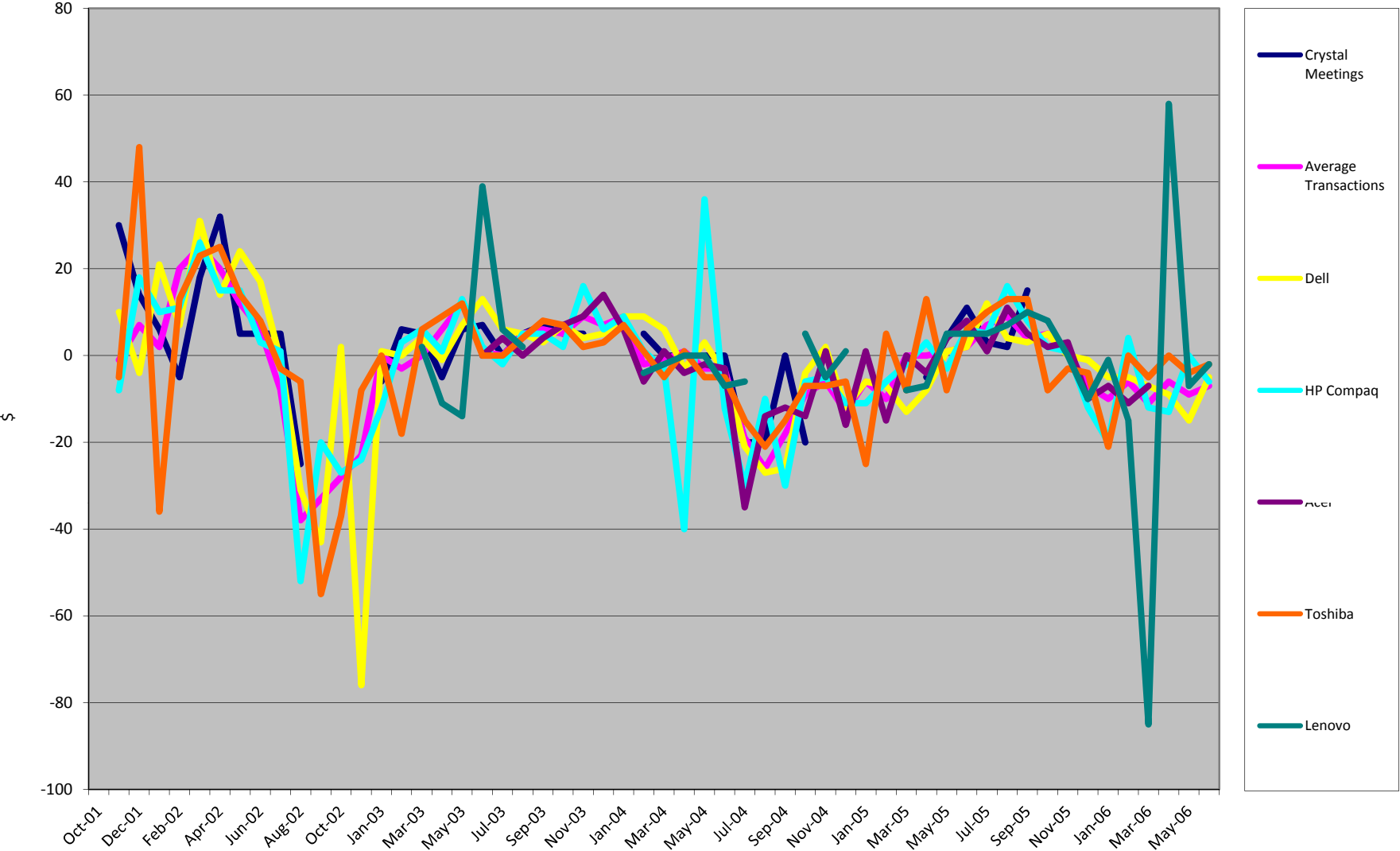




Chart 9D  
First Differences in Prices of 17" SXGA Monitor Panels

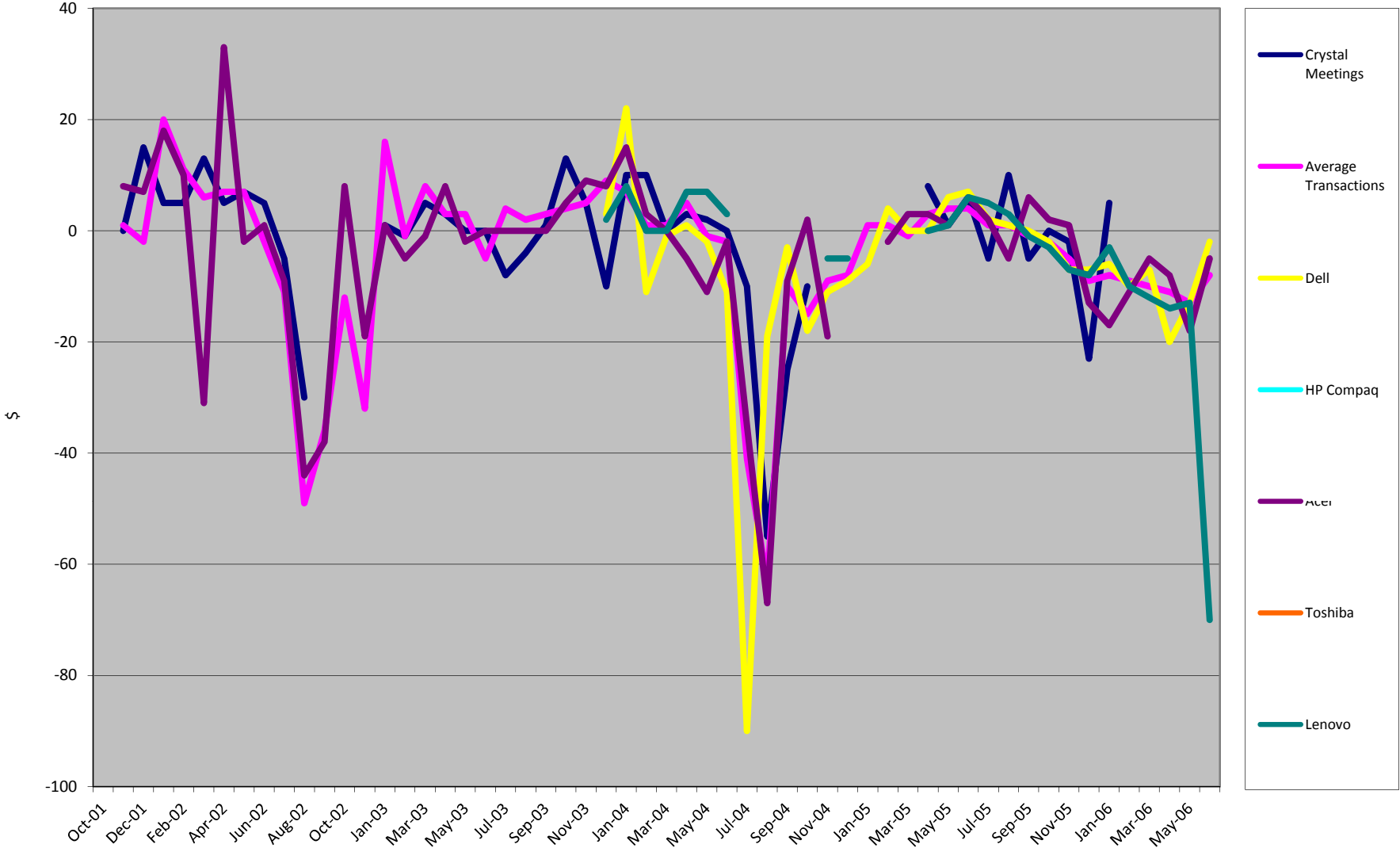


Chart 9E  
First Differences in Prices of 19" SXGA Monitor Panels

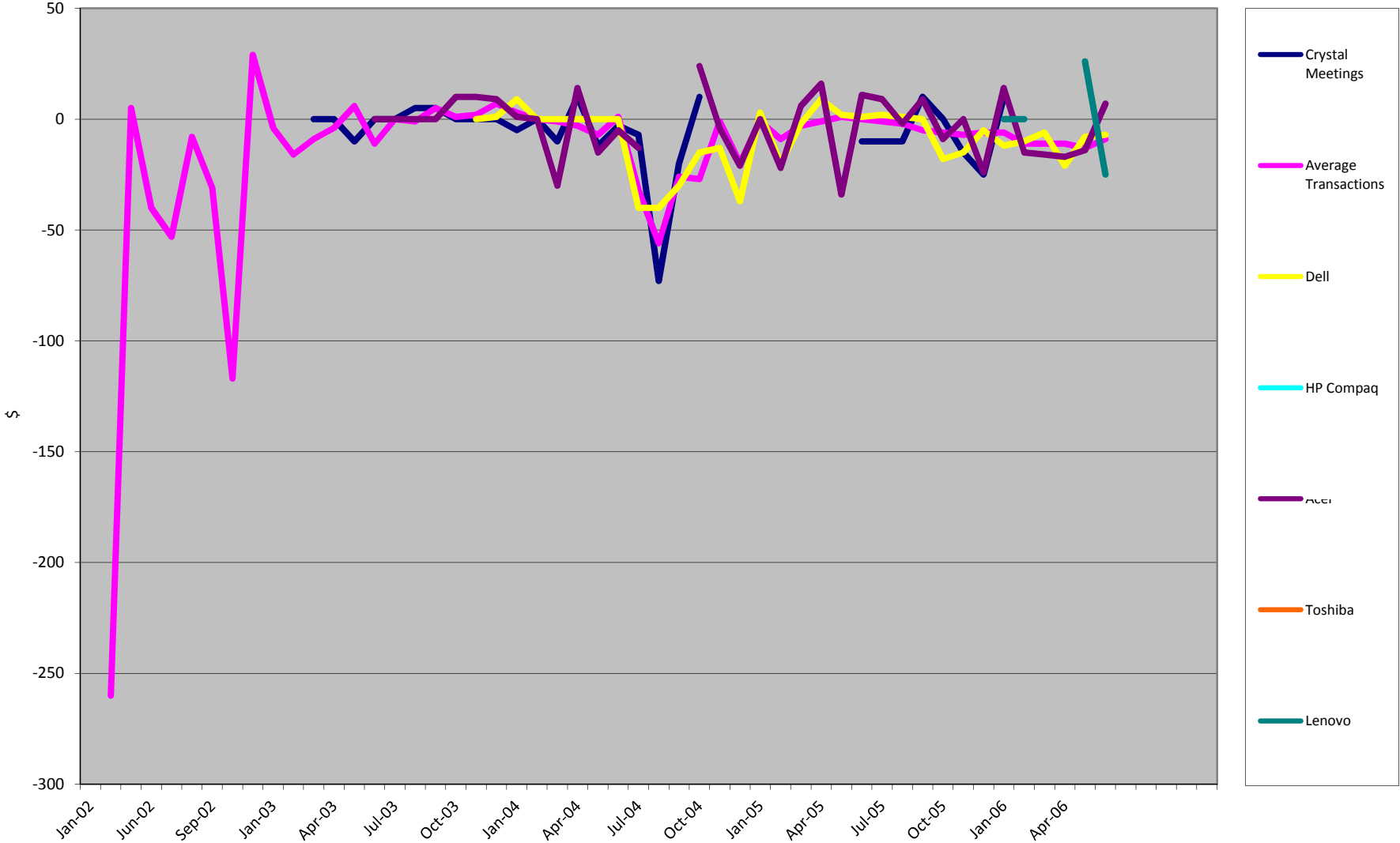


Chart 10A  
Crystal Meeting Prices Other Indexed Prices for 14.1" Notebook Panels

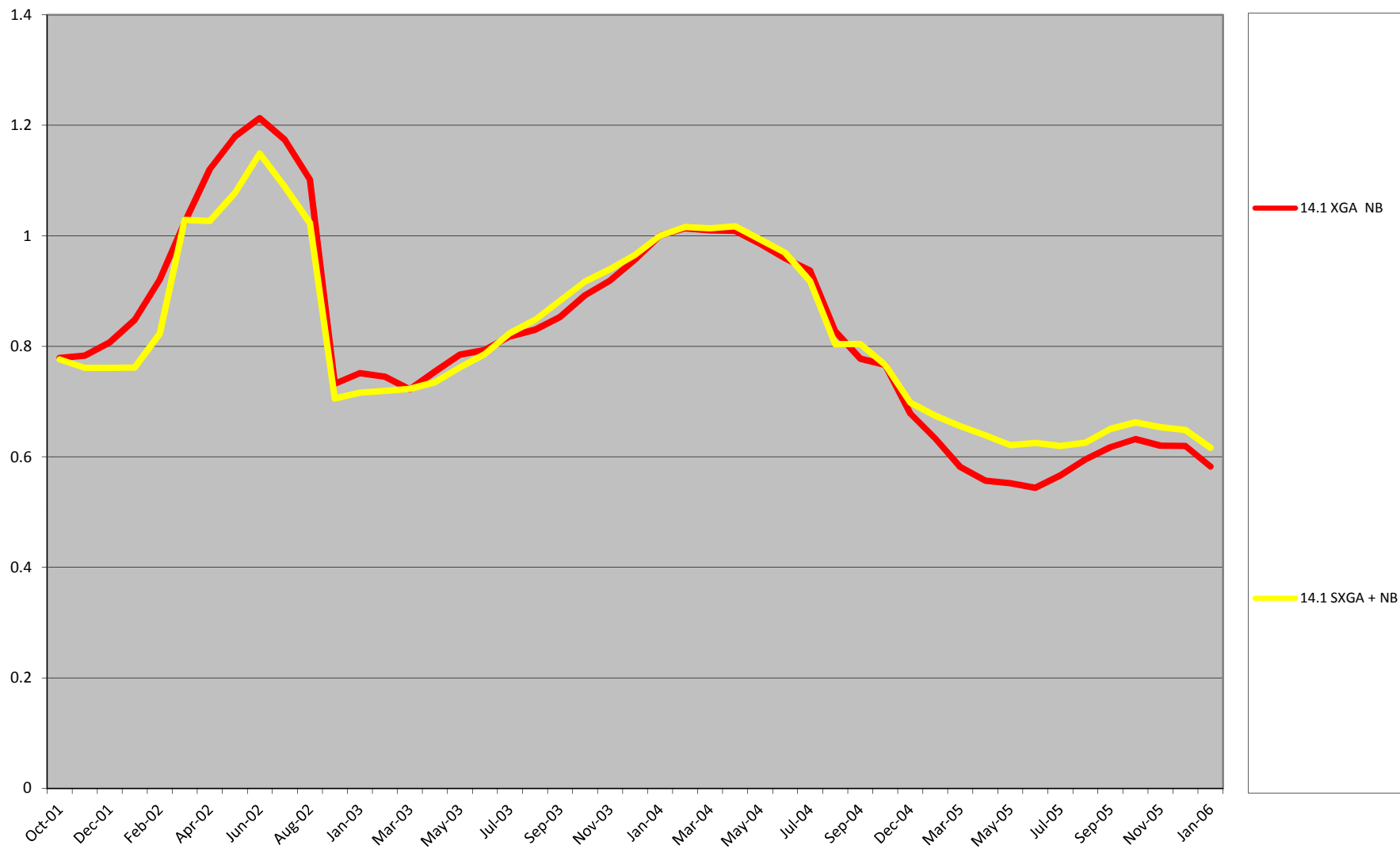


Chart 10B  
Crystal Meeting Prices and Other Indexed Prices for 15-15.4" Panels

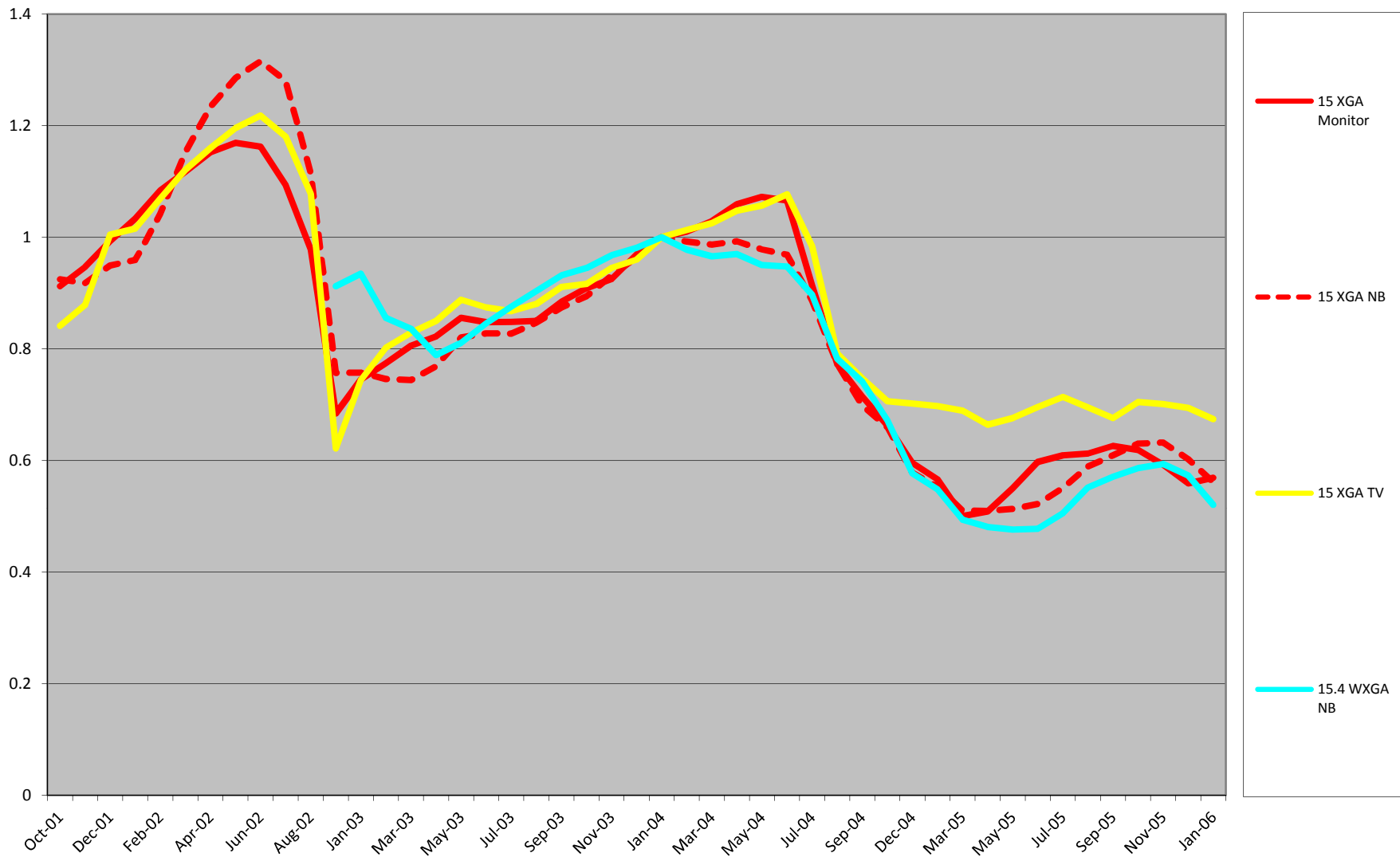


Chart 10C  
Crystal Meeting Prices and Other Indexed Prices for 17-20.1" Panels

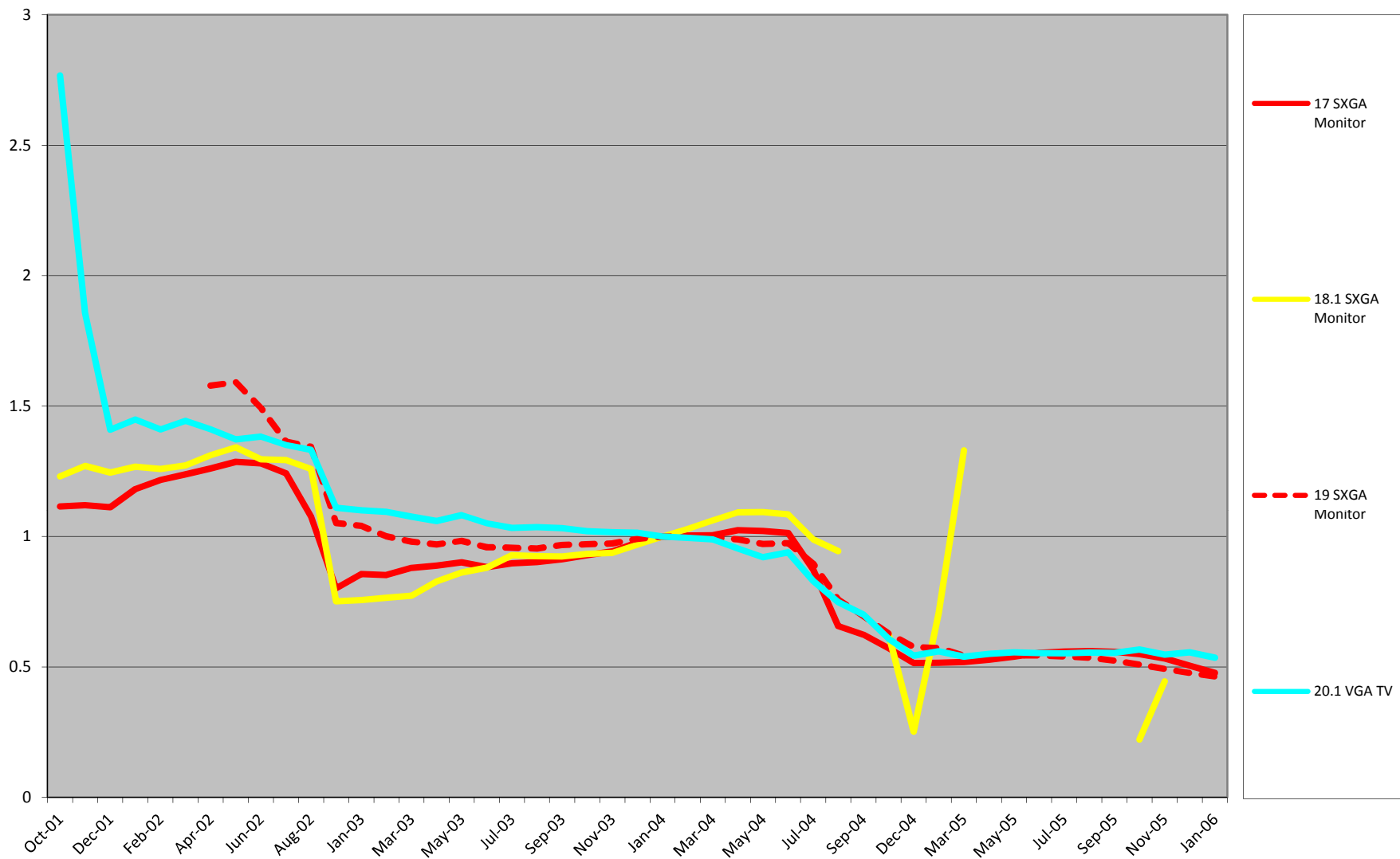
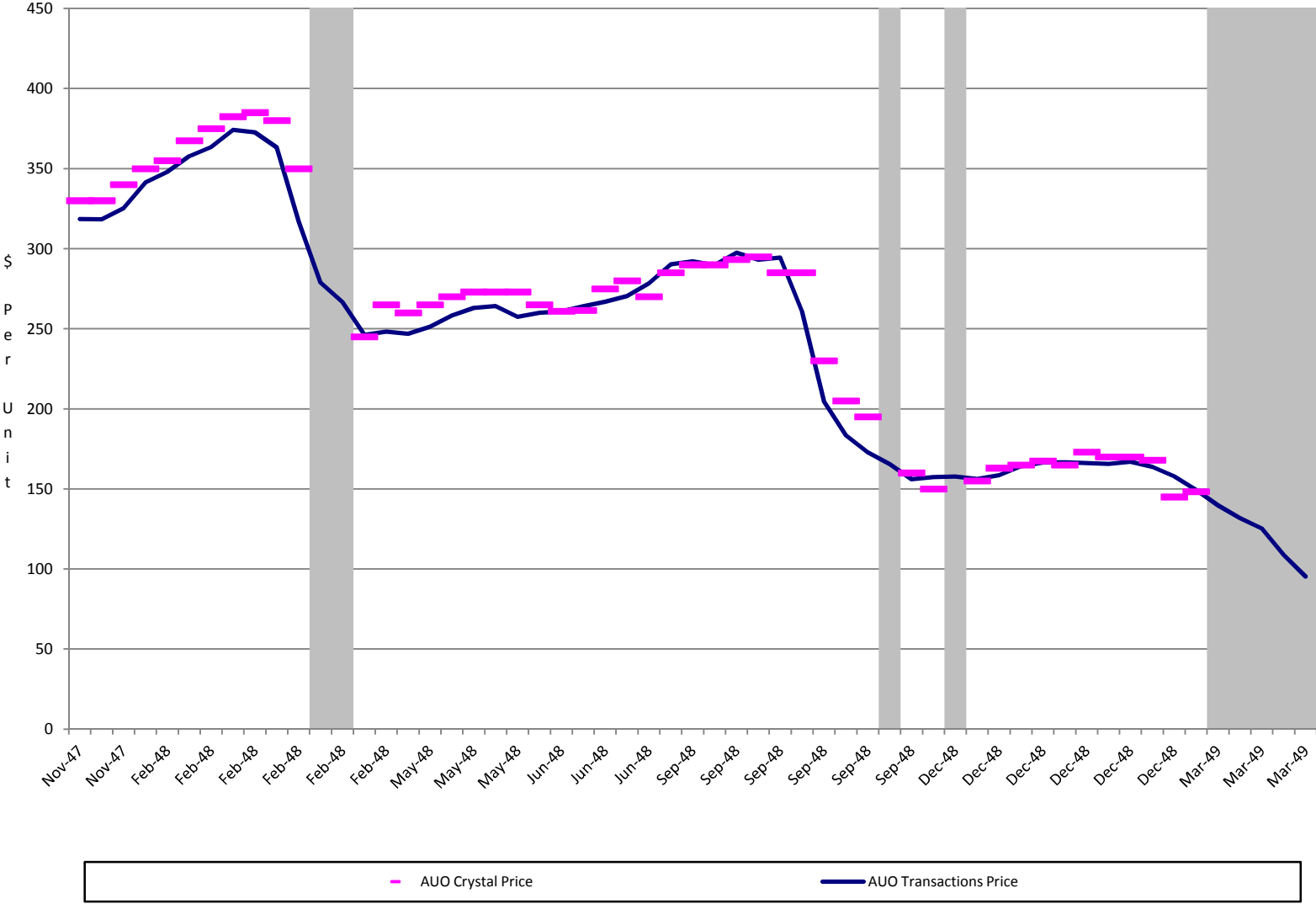


Chart 11  
Crystal Meeting Prices and AUO Actual Prices for 17" SXGA Monitor Panel



Conspiracy Meeting Months are Shaded

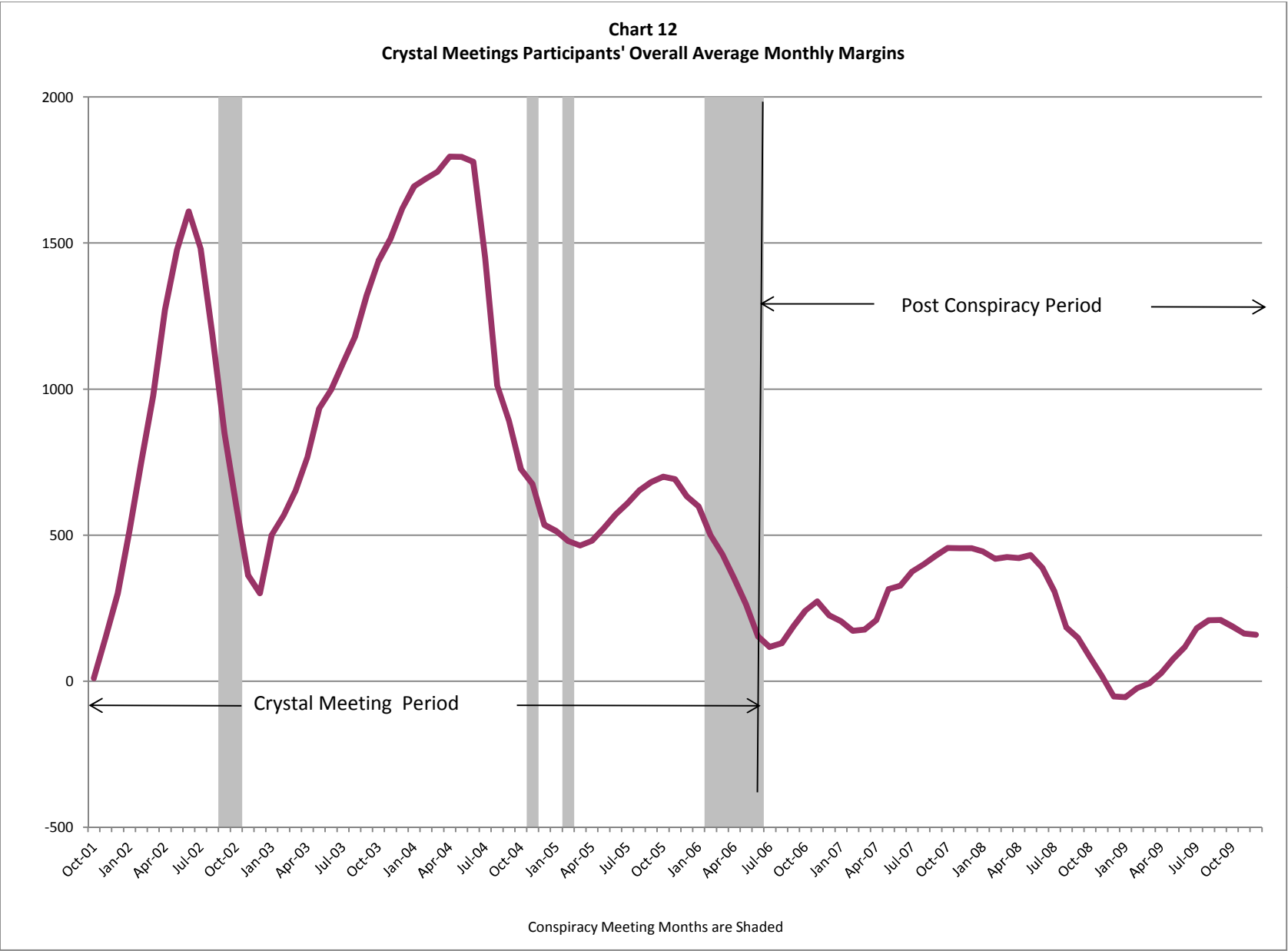


Chart 13A  
Price versus Screen Size, January 2002; All LCD Panels 12.1-30"

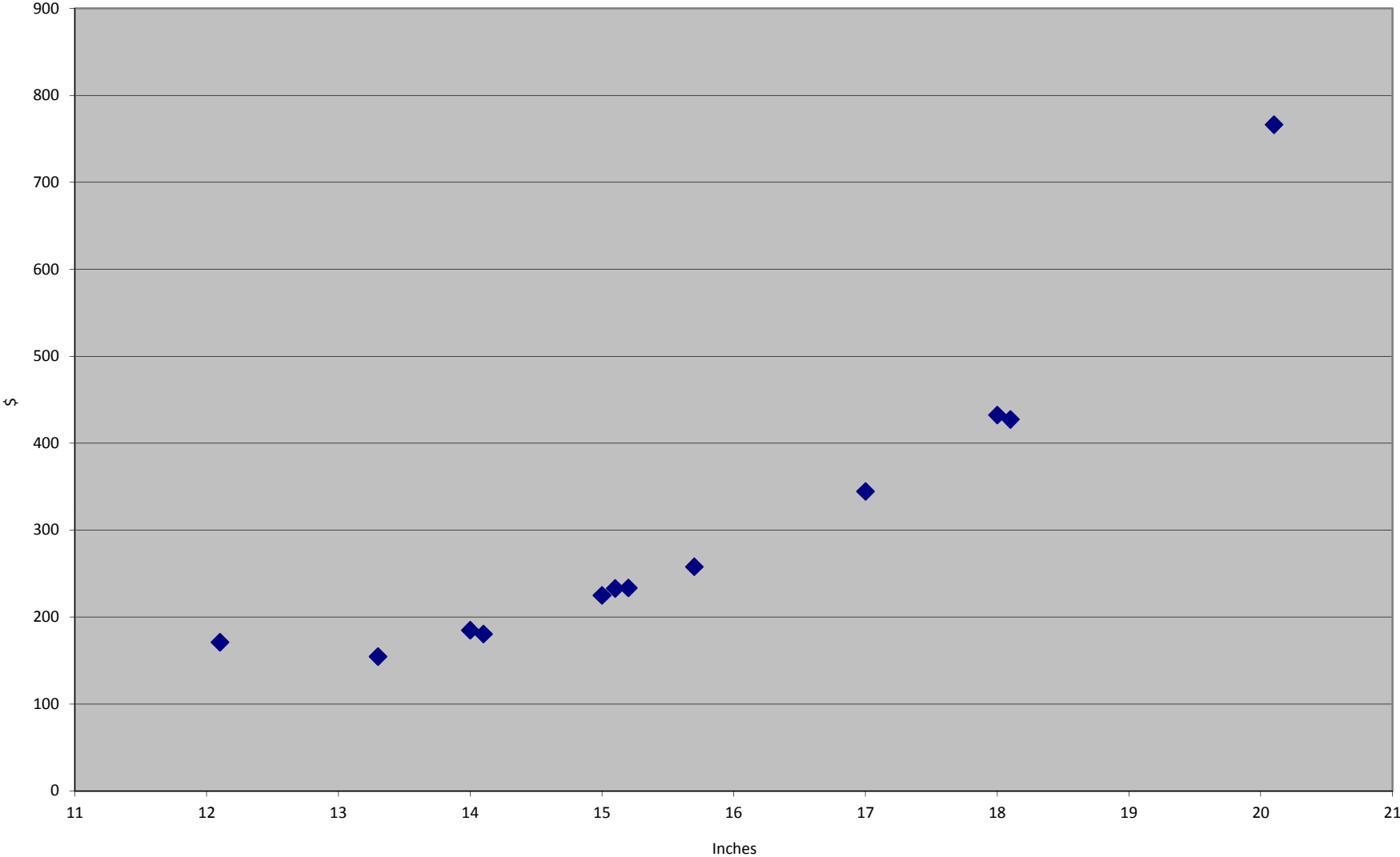




Chart 13B  
Price versus Screen Size, January 2004; All LCD Panels 12.1-30"

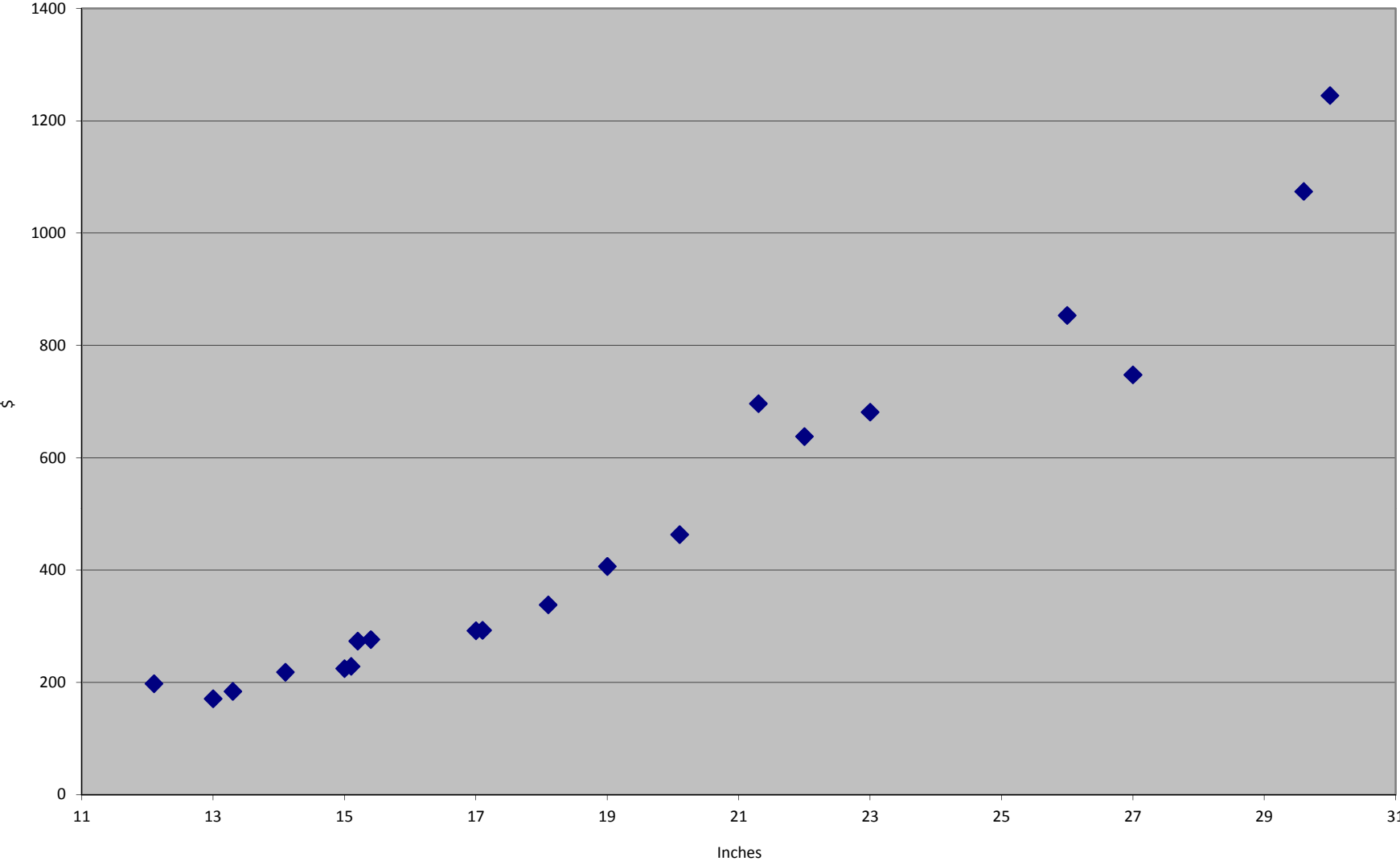


Chart 13C  
Price versus Screen Size, January 2006; All LCD Panels 12.1-30"

