Revisiting Steris/Synergy: Potential Competition and the Expected Value Approach

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Abstract. The 2015 Steris/Synergy merger was the first litigated U.S. merger challenge in more than thirty years to turn on potential competition. The FTC alleged that Synergy's planned U.S. x-ray sterilization facilities would have competed with Steris's gamma sterilization business, while the merging parties argued that Synergy's plans were too tentative and financially weak to support entry. The district court sided with the parties after concluding that Synergy's entry was insufficiently likely. This article develops two themes. First, it reassesses the merger in light of both the contemporaneous record and nearly a decade of subsequent events. While not dispositive, this retrospective evidence suggests Synergy's planned entry was commercially credible and competitively significant: Steris has relied on x-ray for virtually all of its incremental radiation sterilization capacity since the merger; Steris's sterilization margins increased substantially after the merger; and a replication of Synergy's contemporaneous financial model undermines trial testimony that x-ray's projected returns were "woeful" and unlikely to support entry. Second, the article argues that the probability-centric approach to potential competition followed in Steris and other matters is flawed relative to an expected value approach that evaluates mergers based on both the probability of entry and the competitive significance of that entry.

JEL Codes: L40, L41, K21, L13, L80.

I. Introduction

The 2015 merger of Steris and Synergy combined two of the world's three large providers of sterilization services. At the time the merger was announced in late 2014, the U.K.-based Synergy was in the advanced stages of planning a U.S. expansion using x-ray sterilization that would have put it into more direct competition with U.S.-based incumbents Steris and Sterigenics, which relied on gamma sterilization. Synergy announced the expansion publicly, but the merger and ensuing Federal Trade Commission (FTC)

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investigation appear to have contributed to its abandonment. The FTC challenged the transaction on the theory that it would eliminate Synergy's planned entry, but the district court rejected the challenge, relying heavily on testimony that the x-ray plan had poor financial prospects and likely would not have proceeded absent the merger. The case was the first litigated potential competition merger challenge in more than thirty years.

The time is ripe to look back at the Steris/Synergy merger. Potential competition has returned to prominence in merger enforcement, and more than a decade of post-merger history now sheds light on the uncertainty that confronted the Steris court in 2015. Steris's own post-acquisition x-ray expansion provides evidence relevant to the commercial and financial viability of x-ray at the time of trial. The first theme of this article is therefore retrospective: to reassess the merger in light of both the contemporaneous record considered by the court and subsequent events.

The second theme of the paper is doctrinal and analytical: I argue that potential competition analysis should focus on expected competitive harm, which depends jointly on the probability of entry and the competitive significance of entry if it occurs. Both the Steris court and, eight years later, the Meta/Within court explicitly focused on whether the potential entrant would have entered but for the acquisition, asking whether Synergy "probably" would have entered in *Steris* and whether Meta had a "reasonable probability" of entering in *Meta/Within*. The competitive significance of that entry was treated as subordinate to entry probability in *Meta/Within* and received little or no independent weight in *Steris*. Such a probability-centric framework is consistent with one plausible reading of existing case law, but economics favors an expected value approach in which likelihood of entry and magnitude of effects are considered jointly. Relative to an expected value standard, the probability-centric approach applied in *Steris* and *Meta/Within* risks overenforcing mergers involving likely but competitively modest entry and underenforcing mergers that would forestall less certain but highly significant entry. The remainder of the article develops these two themes in turn.

Section II describes the relevant sterilization technologies, market structure, and Synergy's planned x-ray expansion, including the basis for the FTC's allegations that Synergy x-ray and Steris gamma would be in close competition with one another. It then discusses the district court's approach to deciding the matter for the parties, which centered on evaluating the probability with which Synergy would have entered.

Section III presents post-merger evidence that Synergy's abandoned x-ray expansion was likely to have mattered competitively. This retrospective evidence does not show that Synergy's entry was certain, immediate, or likely to unfold exactly as Synergy had originally planned; rather, it is consistent with Synergy's x-ray plans being commercially credible and of material competitive significance.

- **Steris x-ray**: Steris has relied overwhelmingly on x-ray, rather than gamma, for incremental radiation sterilization capacity since the merger.
- **Margins:** Steris's sterilization margins increased substantially after the merger, in ways not readily explained by merger-specific efficiencies.
- **Financial model:** A replication of Synergy's contemporaneous financial model indicates that trial testimony stating that x-ray was financially nonviable rested on economically questionable interpretations.

Section IV reviews both foundational and modern potential competition cases, highlighting the extent to which courts have focused on the probability of entry rather than the competitive significance of the entry foregone.

Section V develops the expected value standard. It first defines expected value by analogy to the way courts and enforcers already evaluate mergers of current competitors: expected consumer harm from lost competition, net of expected consumer benefits from efficiencies. It then explains how that framework applies when the lost competition is potential rather than current, using hypotheticals to show how probability of entry, competitive significance, timing, and efficiencies jointly determine expected competitive harm. It further explains that the approach does not require courts or enforcers to assign precise numerical probabilities, but instead asks them to treat entry likelihood as one input into a broader assessment of competitive effects. The section then addresses materiality, merger screens, and the 2023 Merger Guidelines, and concludes by explaining how the same economic logic applies in other antitrust settings involving uncertain future competition.

Section VI returns to Steris/Synergy and applies the expected value framework to the facts of the case. It evaluates the record along three dimensions relevant to expected value: the likelihood that an independent Synergy would have continued pursuing U.S. x-ray entry, the likely timing of that entry, and the competitive effects that entry would have produced. It argues that the evidence supports a meaningful probability of entry and strong evidence of competitive significance, while also acknowledging that Synergy's 2016 timetable may have been optimistic and that delay, gradual ramp-up, and execution risk should reduce the expected harm attributed to the merger. The section concludes that, viewed through an expected value lens, the merger eliminated a meaningful chance of competitively significant entry, even after accounting for uncertainty about timing, gradual ramp-up, and execution risk.

II. Radiation sterilization and Synergy's U.S. x-ray plan

This section provides a brief overview of the matter's factual record, including the advantages and disadvantages of x-ray over other methods of sterilization (Section II.A); the competitive landscape for sterilization services as of 2015 (Section II.B); Synergy's x-ray expansion plan (Section II.C); and the basis for the district court's decision in favor of the merging parties (Section II.D). Additional details from the contemporaneous factual record are available in Appendix I.

A. Methods of sterilization

Sterilization is the final step in the manufacturing of medical devices and other products requiring sterility, meaning the absence of bacteria and other microorganisms. While some large manufacturers have their own sterilization facilities, most outsource sterilization to contract sterilizers like Steris and Sterigenics, which sterilize products by exposing them to poisonous ethylene oxide (EO) gas (roughly half of U.S. sterilization) or to ionizing radiation (roughly the other half).

The Steris/Synergy merger implicated radiation sterilization. Steris has said that most products (85-90%) are suitable for either radiation or EO, but not both, as an inappropriate sterilization method would "ruin the product."[1] Steris has also stated that "if it could be irradiated, it would be," because irradiation offers benefits over EO.[2] In particular, radiation offers faster turnaround times than EO, and EO is often unsuitable for healthcare applications because it can leave a harmful residue and requires gas permeable packaging and products.[3]

[1] Steris 2020 Q2 earnings call ("There is a small percentage of product that can be done with either [EO or radiation]. [] The preponderance of products are one or the other. [] Maybe 10% or 15% [] could go either way.").
[2] Steris, "Introduction to Industrial Sterilization for Medical Devices," at 14:30, available at https://www.youtube.com/watch?v=-ledNIWTjx0&.
[3] Silor (Zimmer Biomet) transcript, 111:24-112:1; 112:3-4.

There are three methods of radiation sterilization:

- **Gamma**: Cobalt-60, manufactured in nuclear reactors, emits high-energy photons (gamma rays), which disrupt the DNA and proteins of organisms. Gamma rays lack mass or charge and thus can significantly penetrate matter, making gamma suitable for dense products or larger batches of products. Gamma irradiators generally sterilize totes containing multiple boxes of products.
- **X-ray:** An electrically-powered accelerator fires electrons at a tantalum plate, releasing high-energy photons (x-rays), which then incapacitate organisms in the same manner as gamma rays. X-rays have even greater penetration than gamma, making x-ray better suited for dense products or large batches of products. X-ray irradiators generally sterilize whole pallets of products, without requiring the pallet to be broken down and reassembled following processing.
- **E-beam**: An electrically-powered accelerator shoots electrons at products with sufficient energy to disrupt the DNA and proteins of any organisms attached to the products. Because electrons have mass and charge, they cannot significantly penetrate matter, meaning e-beam generally sterilizes one box at a time,[4] rather than totes or pallets, and cannot sterilize dense products.

At the time of the merger in 2015, e-beam accounted for approximately 15% of radiation sterilization in the U.S., with gamma accounting for the remaining 85%.[5] Evidence indicates that the use of e-beam has not meaningfully increased since then.[6]

In 2015, x-ray sterilization was an emerging technology limited to a single Synergy plant in Däniken, Switzerland, constructed in 2010.[7] The central issue in *Steris* was whether Synergy probably would have entered the United States with x-ray facilities absent the merger. If Synergy had entered, the competitive significance of that entry depended in part on how x-ray compared with gamma, including whether customers would have viewed x-ray as a practical alternative to Steris's and Sterigenics's existing gamma facilities. The chief advantages of x-ray over gamma are:

- **Greater penetration and throughput:** X-ray is better able to sterilize whole pallets as shipped by the manufacturer, whereas gamma irradiators typically require more handling with concomitant greater processing time[8] and risk of product damage.[9]
- **Tighter dose uniformity:** Unlike gamma, x-rays can be directed, offering tighter dose uniformity (the ratio of maximum dose to minimum dose)[10] and thus more predictable dosage.

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[4] See E-BEAM Services, "Who Is E-Beam Sterilization For?" ("Processing at E-BEAM is [] not a good fit for extremely dense materials."); available at https://ebeamservices.com/e-beam-sterilization/.
[5] FTC v. Steris Corp., No. 1:15-cv-01080, slip op. (N.D. Ohio Sept. 24, 2015) (hereafter "Decision"), at 2.
[6] IBA Signs Contract to Install a Fully Integrated X-Ray Irradiation Solution in France, IBA Industrial Solution, Dec. 22, 2022, (saying gamma and EO are 90% of sterilization), available at https://www.iba-industrial.com/iba-signs-contract-to-install-a-fully-integrated-x-ray-irradiation-solution-in-france/.
[7] Decision, at 3. As wot why no other competitors had pursued x-ray, the FTC's complaint alleged that "Synergy has entry advantages in x-ray that no other firm can match, including its global scale, a reputation as a quality service provider, a head-start of several years, and, as of the date of the transaction, a ten-year exclusive agreement with the world's only supplier of commercially viable x-ray sterilization machines. No other firm is attempting to enter the United States with x-ray sterilization services capable of competing effectively with gamma sterilization." Complaint, at 5.
[8] Transcript of Proceedings, FTC v. Steris Corp., No. 1:15-cv-01080 (N.D. Ohio Aug. 12, 2015) (hereafter "[witness name] Transcript"), Hansen (Johnson & Johnson), 46:14-17 ("It might take us up to seven days to get our product through a gamma site []; going through an x-ray radiator will be a short period of time, typically one to two days.")
[9] Tyranski (Synergy) Transcript, 514:16-22.
[10] McLean (Synergy) Transcript, 369:2-3.

- **Less heat:** X-ray produces less heat than gamma, avoiding damage to some products.[11]
- **Can be turned off:** Cobalt-60 continuously emits gamma rays, with a dose that varies as it decays. An x-ray machine can be turned on and off.
- **Certainty of supply:** One of two large suppliers of Cobalt-60 (Nordion) is owned by Steris's chief rival Sterigenics; the other is Russian, and subject to U.S. sanctions.[12] Nordion itself depends on Russian reactors to manufacture Cobalt-60.[13] Synergy documents indicate that moving away from Cobalt-60 was attractive to both Synergy and its customers.[14]
- **Faster turnaround time:** Because x-ray does not require de-palletizing and re-palletizing boxes, x-ray sterilization can be significantly quicker than gamma.[15]

The two main disadvantages of x-ray relative to gamma are:

- **Fixed cost of x-ray facilities**: In 2015, an x-ray accelerator accounted for approximately 25-30% of the total cost of an x-ray facility.[16] A gamma facility requires similar ancillary systems but does not require an accelerator (instead requiring Cobalt-60 and equipment to handle the Cobalt-60).
- **Costs to customers of changing facilities:** Medical device manufacturers must test and validate any change in sterilization,[17] including switching from gamma to x-ray, which is costly.[18]

The economic case for x-ray therefore depended on whether its ongoing operational and product-level advantages were large enough to overcome both the fixed cost of building x-ray capacity and the switching costs customers would incur in moving products to that capacity.

B. The competitive landscape in 2015

At the time of the merger, Steris operated 11 U.S. gamma facilities, nine U.S. EO facilities, and one gamma facility in Canada.[19] Synergy operated five U.S. e-beam facilities, one U.S. EO facility,[20] 17 gamma facilities in Europe, Africa, and Asia, and one x-ray facility in Däniken, Switzerland. Sterigenics operated 14 U.S. gamma facilities, ten U.S. EO facilities, one U.S. e-beam facility, and 22 gamma, EO, and e-beam facilities in Europe and Asia.[21] A small U.S. fringe also offered e-beam services, with the FTC alleging that these providers lacked the expertise of Steris, Synergy, and Sterigenics.[22]

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[11] Tyranski (Synergy) Transcript, 515:17-22.
[12] Sotera (Nordion) 2024 Annual Report, at 11 ("Nordion's two main competitors in the industrial LSA Co-60 sources supply market are a Russian Co-60 sources producer, which historically has supplied certain regions in Europe and Asia, and a China-based producer, which supplies the domestic Chinese market.")
[13] *Id.*
[14] McLean (Synergy) transcript, 305:19-306:4 (stating that concerns about Cobalt-60 availability had led to a "market environment [that is] starting to move very slowly towards recognition that x-ray and e-beam will be the key sterilization technologies of choice into the long-term future").
[15] Hansen (Johnson & Johnson) Transcript, 46:9-17 ("It might take us up to seven days to get our product through a gamma site [] going through an x-ray radiator will typically be a short period of time, typically one to two days.").
[16] As described in Section III.C, Synergy modeled the cost of an x-ray facility to be $20.2 million and the cost of the accelerator to be EUR 5.2-5.3 million. See Tyranski (Synergy) transcript, at 615:22-616:5 and 616:22-617:5.
[17] McLean (Synergy) Transcript, 363:11-24.
[18] Hansen (Johnson & Johnson) Transcript 73:20-22, 74:22-75:4, 197:5-8.
[19] Steris home page, archived as of May 2, 2015, available at https://web.archive.org/web/20150502215058/http://www.isomedix.com/.
[20] Tyranski (Synergy) Transcript, 586:20-22.
[21] Complaint for Temporary Restraining Order and Preliminary Injunction, FTC v. Steris Corp., No. 1:15-cv-01080-DAP (N.D. Ohio May 29, 2015) (hereafter "Complaint"), at 2.
[22] The FTC stated that smaller providers disproportionately sterilized non-medical items, such as spices or soil. *Id.*, at 69.

The FTC alleged two product markets: 1) contract radiation sterilization services, consisting of gamma, x-ray, and e-beam sterilization;[23] and 2) contract gamma and x-ray sterilization services sold to targeted customers that would not switch to e-beam.[24] These product markets do not appear to have been disputed at trial, and are consistent with statements by Steris indicating little substitution between radiation and EO.[25] The record indicates that Steris, Synergy, and Sterigenics controlled substantially all of the first market, while Steris and Sterigenics controlled substantially all of the second market.[26] Though the market shares alleged by the FTC are redacted from the public record, the fact that the second market consisted solely of Steris and Sterigenics implies that its HHI was at least 5,000.[27] Synergy documents contemplated its new x-ray facilities taking 15% of the gamma share over time,[28] which, if the plans had come to fruition, would have materially lowered concentration in any alleged geographic market. The FTC alleged geographic markets around each planned Synergy facility.[29]

C. Synergy's planned x-ray entry

Synergy documents indicate that beginning in 2012, Synergy management developed plans to expand into the United States using x-ray.[30] These documents described x-ray as a potential "game changer" that could allow Synergy to compete more effectively with Steris and Sterigenics.[31] Synergy management planned to target gamma customers of Steris and Sterigenics.[32] Synergy did not believe it could successfully compete by offering gamma, EO, or e-beam,[33] but saw "a competitive advantage over competitors with the knowledge and experience in x-ray technology," by virtue of Synergy having operated its x-ray facility in Däniken, Switzerland since acquiring that facility in 2010.[34]

By mid-2014, Synergy's U.S. management team had identified potential sites in Indiana and Texas,[35] engaged an accelerator supplier,[36] sought and obtained tax incentives from state and local governments,[37] and conducted outreach to large medical-device manufacturers regarding x-ray.[38] Presentations to

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[23] Complaint, at 5.
[24] Complaint, at 8.
[25] See note 1, *supra*.
[26] A contemporaneous Synergy document stated that the combined U.S. share of Steris and Sterigenics was 83% for radiation sterilization (i.e., including e-beam) and 90% for EO. See Steeves (Synergy) Transcript, 152:16-19.
[27] The minimum HHI that can be associated with only two competitors is 5,000, i.e., $50^2+50^2 = 5{,}000$.
[28] McLean (Synergy) Transcript, 316:6-22.
[29] The FTC then alleged five geographic markets, in areas roughly 500 miles from each of five planned Synergy U.S. x-ray facilities. See Complaint, at 3. To illustrate the magnitude of Synergy's contemplated 15% share, if a new entrant takes a 15% share proportionally from two incumbents, the smallest HHI reduction occurs when the incumbents initially have equal shares. In that case, pre-entry shares are 50% and 50%, and post-entry shares are 42.5%, 42.5%, and 15%. Pre-entry HHI is $50^2 + 50^2 = 5{,}000$, while post-entry HHI is $42.5^2 + 42.5^2 + 15^2 = 3{,}837.5$, implying an HHI reduction of 1,162.5 points.
[30] Steeves (Synergy) Transcript, 151:21-154:15.
[31] Steeves (Synergy) Transcript, 157:10-18.
[32] Steeves (Synergy) Transcript, 154:20-155:1 (describing a Synergy document titled "x-ray expansion in the U.S" stating that the expansion would target over 120 million of revenue from the two largest players)
[33] Steeves (Synergy) Transcript: 152:23-153:1.
[34] Steeves (Synergy) Transcript, 153:10-14 ("we do, however, currently hold a competitive advantage over competitors with the knowledge and experience in x-ray technology").
[35] Tyranski (Synergy) Transcript, 508:20-509:2; 542:3-544:16.
[36] Steeves (Synergy) Transcript, 162:8-21; McLean (Synergy) Transcript, 320:19-24.
[37] Tyranski (Synergy) Transcript, 508:20-509:2; 542:3-544:16.
[38] Tyranski (Synergy) Transcript, 506:3-7 (indicating that Synergy told one large customer, Covidien, that "Synergy is in the final stages of gaining board approval for wholesale investments in x-ray capacity in the Americas as an alternative to gamma in the U.S., at comparable pricing.").

Synergy's senior leadership stated that at least two U.S. x-ray facilities would begin operations in 2016.[39] In September 2014, Synergy's Senior Executive Board approved the U.S. x-ray strategy,[40] after which Synergy publicly announced the planned deployment of x-ray technology in the United States.[41]

Steris announced its agreement to acquire Synergy on October 13, 2014.[42] Synergy publicly announced to investors that it was expanding into the U.S. with x-ray on November 4, 2014.[43] However, Synergy slowed certain aspects of the x-ray rollout following the announcement of the merger, including its market development and site selection,[44] with management indicating that elements of the plan would be revisited following the closing of the transaction.[45] Nevertheless, Synergy continued to pursue site selection, customer outreach, and preliminary operational planning into early 2015.[46] During this period, customers sent products to Synergy's Däniken facility for x-ray testing,[47] and Synergy communicated with its accelerator supplier regarding future U.S. installations.[48]

In February 2015, shortly after meeting with FTC staff who expressed concerns that the merger would eliminate Synergy's planned x-ray entry,[49] Synergy terminated its U.S. x-ray expansion.[50] A contemporaneous Synergy email describing the termination decision stated: "This whole FTC inquiry is going down a rat hole and I'm going to have to communicate to [accelerator supplier] IBA soon that we cannot proceed for the Americas."[51] The FTC alleged that the merger itself caused Synergy to abandon its entry plans.

Synergy documents and testimony indicated that it expected x-ray to constrain gamma pricing.[52] Internal documents and testimony predicted direct competition with Steris and Sterigenics, anticipated a "pricing war,"[53] and recognized that Synergy was expanding in the U.S. rather than the U.K. to take gamma business from incumbents rather than cannibalize Synergy's U.K. gamma operations.[54] Synergy

[39] McLean (Synergy) Transcript, 313:2-6.
[40] McLean (Synergy) Transcript, 321:12-21.
[41] Steeves (Synergy) Transcript, 166:25-167:3.
[42] STERIS Corp., STERIS to Acquire Synergy Health for $1.9 Billion in Cash and Stock (Oct. 13, 2014), https://sterisplc.gcs-web.com/news-releases/news-release-details/steris-acquire-synergy-health-19-billion-cash-and-stock/.
[43] Steeves (Synergy) Transcript, 166:25-167:3.
[44] Tyranski (Synergy) Transcript, 532:1-6 (Tyranski email stating "we've made a difficult but sensible decision to stop any market development expense on x-ray outside the already budgeted and ongoing activity in Däniken/Europe while we wait for the Steris transition."); McLean (Synergy) Transcript, 356:19-357:4 (November 2014 McLean management report stating "The U.S. x-ray strategy is now approved. [] However, final selection of the first two sites is on hold, pending network study of the combined STE/SYR network.")
[45] Tyranski (Synergy) Transcript, 532:16-23 (Tyranski email stating "I [] imagine we will have to re-present the business case to the new Steris board.")
[46] Tyranski (Synergy) Transcript, 550:21-552:16.
[47] Haemonetics: Tyranski (Synergy) Transcript, 553:4-8. Thermo Fisher: Tyranski Transcript, 553:23-25. Zimmer: Tyranski (Synergy) Transcript, 554:1-5. Tyranski (Synergy) Transcript, 553:23-25.
[48] Tyranski (Synergy) Transcript, 557:3-10 and 559:6-13.
[49] McLean (Synergy) Transcript, 358:4-15.
[50] McLean (Synergy) Transcript, 340:24-341:2.
[51] McLean (Synergy) Transcript, 358:22-359:5.
[52] For instance, see McLean (Synergy) Transcript, 302:10-15 ("Q: One of the things that Synergy had identified that might result if it entered with x-ray was that Steris and Sterigenics might drop prices for gamma. Correct? A: Yes.")
[53] McLean (Synergy) Transcript, 320:10-12.
[54] McLean (Synergy) Transcript, 431:11-20 (describing a Synergy document stating that any future x-ray plant should be built in the U.S. rather than the U.K. as "if an x-ray facility was built in the U.K., the probable effect would be to cannibalize the gamma business.")

management anticipated a "street fight" between Synergy x-ray and Steris and Sterigenics gamma.[55] After Steris's acquisition of Synergy was announced, Synergy treated plant location as sensitive[56] because an x-ray site could function as a "gamma beater" against a nearby Steris site.[57]

The limited contemporaneous evidence from potential x-ray customers expresses both enthusiasm for x-ray and caution about switching products from gamma to x-ray. For instance, Johnson & Johnson viewed Synergy as the most innovative of the major providers[58] and saw real advantages to x-ray,[59] though hedged at trial as to how quickly it would shift volumes to x-ray.[60]

D. The court's probability analysis

At trial, Synergy executives testified that x-ray's financial prospects were poor and fell well below Synergy's internal thresholds for capital investments.[61] In particular, executives emphasized that Synergy required a minimum internal rate of return of fifteen percent for major projects when calculated over the first ten years of operation, and that the x-ray model produced a substantially lower return.[62] They further testified that Synergy's board would not have approved the necessary capital expenditures without binding customer commitments—described as "take-or-pay" contracts—which Synergy had been unable to secure.[63] Finally, Synergy witnesses testified that formal approval from Synergy's PLC board had not been obtained, and that the Senior Executive Board's September 2014 endorsement reflected only a preliminary strategic direction rather than a commitment of funds.[64]

The FTC challenged each of these claims. The agency questioned whether Synergy's asserted financial thresholds were supported by contemporaneous documents,[65] whether Synergy in fact evaluated projects by ignoring profits beyond a ten-year horizon,[66] and whether customer commitments of the type described by executives were a prerequisite for prior expansions.[67] The FTC also pointed to internal documents reflecting sustained managerial support for the x-ray strategy and continued operational progress up until the February 2015 meeting with FTC staff.[68]

The district court sided with the merging parties, crediting testimony that the x-ray project failed Synergy's financial criteria, lacked sufficient customer demand, and had not received final corporate approval. The court placed particular emphasis on the timing of Synergy's abandonment of the project, reasoning that if the merger itself had foreclosed entry, Synergy would have ceased pursuing x-ray immediately after the transaction was announced in October 2014.[69] Instead, the court viewed the

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[55] McLean (Synergy) Transcript, 323:4-10.
[56] Tyranski (Synergy) Transcript, 532:1-6.
[57] Tyranski (Synergy) Transcript, 533:8-12.
[58] Hansen (Johnson & Johnson) Transcript, 50:12-51:11.
[59] Hansen (Johnson & Johnson) Transcript, 45:14-46:17.
[60] Hansen (Johnson & Johnson) Transcript, 57:12-58:6.
[61] Hill (Synergy) Transcript, 661:14-18.
[62] Hill (Synergy) Transcript, 661:14-18.
[63] Steeves (Synergy) Transcript, 204:1-9; McLean (Synergy) Transcript, 379:3-10.
[64] McLean (Synergy) Transcript, 419:8-420:14.
[65] Hill (Synergy) Transcript, 735:15-736:4; 738:4-15.
[66] Hill (Synergy) Transcript, 734:12-735:7.
[67] Tyranski (Synergy) Transcript, 641:11-13.
[68] FTC opening arguments, Transcript, 12:17-13:5.
[69] Decision, at 39-40 ("the best evidence that it was done for legitimate business reasons, as opposed to anti-competitive ones" since "if the merger with Steris was going to prevent Synergy from entering the U.S. market, Synergy would have stopped working on the U.S. x-ray project as soon as the merger was announced in mid-October 2014.")

February 2015 termination—four months later and shortly after the FTC meeting—as evidence that management independently concluded the project was not viable.[70]

The court framed the case as turning on whether Synergy "probably" would have entered the U.S. radiation sterilization market with x-ray facilities absent the merger,[71] concluding that the FTC had not proven this. The decision thus effectively treated entry probability as dispositive, leaving little room for the separate question of how competitively significant Synergy's entry would have been if it occurred.

The *Steris* court's probability-centric approach is central to the remainder of the paper. I first reassess evidence on the likelihood of Synergy's entry with the benefit of hindsight (Section III), before a broader discussion of judicial approaches to potential competition matters (Section IV). I then argue that a probability-centric approach to potential competition matters is inferior to an expected value standard that considers both the probability of entry and the competitive significance of that entry (Section V), before returning to the *Steris* court's decision, discussing and evaluating it both on its own terms under its probability-centric approach and under an expected value standard (Section VI).

III. Retrospectively assessing the Steris/Synergy merger

This section describes Steris's post-merger deployment of x-ray sterilization (Section III.A), Steris's increasing revenue and margins, which are consistent with—even if not a dispositive indicator of—increased market power (Section III.B), and a replication of the Synergy financial model relied upon by Synergy executives when testifying that x-ray was financially nonviable (Section III.C).

A. Steris has relied on x-ray for nearly all of its incremental radiation sterilization capacity from 2019-present

Steris itself turned to x-ray at scale, beginning less than four years after closing its merger with Synergy, and continuing to the time of writing. Indeed, Steris appears to have used x-ray for the vast majority of its incremental radiation sterilization capacity added since its merger with Synergy. Relative to Synergy, Steris had the advantages of existing U.S. locations at which it could co-locate new x-ray facilities, and a more extensive U.S. customer base from which it could draw x-ray volumes. Nonetheless, Steris's own x-ray expansion indicates that it saw x-ray as commercially and financially viable soon after it closed its merger with Synergy.

Steris's later investment in x-ray does not show that an independent Synergy would have made the same investment decision. But it is relevant to assessing the competing views of x-ray presented in the record. Steris's expansion is more consistent with Synergy's pre-merger documents describing x-ray as a promising vehicle for U.S. entry than with the dour assessment of x-ray Synergy offered at trial. At a minimum, Steris's subsequent conduct is difficult to reconcile with the proposition that x-ray was commercially nonviable in the United States. The retrospective evidence is therefore not dispositive, but it provides useful context for evaluating both the credibility of Synergy's pre-merger plans and the commercial viability of the expansion strategy that the FTC alleged the merger would eliminate.

In rolling out its own x-ray facilities, Steris had the advantage of existing U.S. gamma facilities and customers, which may have made deployment of x-ray easier. On the other hand, Steris also had an incentive that Synergy largely lacked: any x-ray expansion could divert business from Steris's own

[70] Decision, at 39-40 ("the fact that McLean and Tyranski decided to terminate the project in February 2015, four months after the merger was announced and in the midst of the FTC's investigation, supports the conclusion that this was a decision reached by the project managers after serious consideration of all the business factors involved.")
[71] Decision, at 28.

gamma facilities, whereas an independent Synergy would not have internalized the lost gamma profits if its x-ray facilities took gamma business from Steris and Sterigenics. The fact that Steris invested in x-ray despite that cannibalization risk makes its subsequent conduct relevant to the commercial viability of x-ray, even if it does not establish that Synergy would have entered on the same scale or timeline.

Steris has opened or announced 11 x-ray facilities. Beginning in October 2019—less than four years after Steris closed its acquisition of Synergy—Steris announced that it would build three new x-ray facilities in the U.S.—in Libertyville, Illinois;[72] Ontario, California;[73] and Chester, New York[74]—and a fourth in Venlo, Netherlands.[75] Three of those x-ray facilities—in Libertyville, Venlo, and Chester—have since opened, Libertyville in July 2024,[76] Venlo in March 2022,[77] and Chester in June 2026.[78] Steris has stated on earnings calls that its other announced U.S. x-ray facility—in Ontario, California , is under development.[79] Steris has opened four additional x-ray facilities, in Chonburi, Thailand (2024);[80] Kuala

[72] STERIS AST, STERIS Announces Expansion of Libertyville South, Illinois Facility to Include X-ray Processing (Nov. 7, 2019), https://www.steris-ast.com/news-and-events/news/steris-announces-expansion-of-libertyville-south-illinois-facility-to-include-x-ray-processing.

[73] STERIS AST, STERIS Announces Expansion of Ontario, California Facility to Include X-ray Processing (Jan. 7, 2020), https://www.steris-ast.com/news-and-events/news/steris-announces-expansion-of-ontario-california-facility-to-include-x-ray-processing.

[74] STERIS AST, STERIS Announces Expansion of Northborough, Massachusetts Facility to Include X-ray Processing (Oct. 9, 2019), https://www.steris-ast.com/news-and-events/news/steris-announces-expansion-of-northborough-massachusetts-facility-to-include-x-ray-processing. The Northborough facility appears to have since been relocated to Chester, NY. Steris announced the Northborough facility and purchased a warehouse adjacent to its Northborough gamma facility, but did not receive a necessary permit from the Northborough Planning Board, and later sold the warehouse it had purchased. On Steris's 2022 Q4 Earnings Call, Steris announced that it planned to open an x-ray facility in Chester, NY ("in the U.S., there's three facilities that will come online over the next couple of years. The earliest will be late -- very late this fiscal year, most likely in Illinois. And then followed by either California or Chester, New York.") See Steris, Northborough Planning Board Case Dismissed, Community Advocate (Oct. 26, 2022), https://www.communityadvocate.com/2022/10/26/steris-northborough-planning-board-case-dismissed/; Framingham Investment Firm Buys Northborough Manufacturer's Property for $6.7M, Worcester Bus. J. (Jan. 23, 2023), https://wbjournal.com/article/framingham-investment-firm-buys-northborough-manufacturers-property-for-67m/.

[75] STERIS AST, STERIS Announces Expansion of Venlo, The Netherlands Facility to Include X-ray Processing (Oct. 21, 2019), https://www.steris-ast.com/news-and-events/news/steris-announces-expansion-of-venlo-the-netherlands-facility-to-include-x-ray-processing.

[76] STERIS AST, STERIS Announces Completion of Libertyville, Illinois Expansion to Include X-ray Processing (June 24, 2024), https://www.steris-ast.com/news-and-events/news/steris-announces-completion-of-libertyville-illinois-expansion-to-include-x-ray-processing.

[77] STERIS AST, X-ray Sterilization Facility in Venlo, The Netherlands (Mar. 17, 2022), https://www.youtube.com/watch?v=rdR71u6wTYA&t (stating the facility was open).

[78] STERIS AST, STERIS Announces Completion of Chester, New York Expansion To Include X-ray Processing (June 25, 2026), https://www.steris-ast.com/news-and-events/news/202606-steris-announces-completion-of-chester-new-york-expansion-to-include-x-ray-processing.

[79] STERIS plc, Q1 2021 Earnings Call Transcript ("And then we have other builds going on the West Coast and the East Coast that will follow after the Libertyville operation comes online.").

[80] STERIS AST, STERIS Announces Completed Expansion of Chonburi, Thailand Facility Now Includes X-ray Processing (Apr. 2, 2024), https://www.steris-ast.com/news-and-events/news/steris-announces-completed-expansion-of-chonburi-thailand-facility-now-includes-x-ray-processing.

Ketil, Malaysia (2023);[81] Suzhou, China (2025);[82] and Hochstadt, Germany (2026).[83] Steris has announced, but not yet opened, two additional x-ray facilities outside of the U.S., including a second x-ray facility in Venlo[84] and a new facility in Tullamore, Ireland.[85] Altogether, as of September 2026, Steris has eight operating x-ray facilities[86] and three additional announced but not-yet-opened facilities,[87] for a total of 11 open or announced x-ray facilities.

As points of comparison, at the time of the merger, Steris operated 12 gamma facilities (11 in the U.S. and one in Canada) and Synergy 16 (all in Europe, Africa, and Asia). Since Steris's November 2015 acquisition of Synergy, Steris has opened just one new gamma facility, in Chonburi, Thailand, meaning that x-ray has accounted for virtually all of Steris's incremental radiation capacity added since its acquisition of Synergy. Steris has not closed any gamma facilities since its acquisition of Synergy.[88]

X-ray has a material share of Steris's radiation capacity. While precise measurement of Steris's capacity is not practical using public data, I estimate x-ray's share of Steris's sterilization capacity under four related metrics and sets of assumptions, finding that by any reasonable metric, x-ray is a material component of Steris's radiation sterilization network. Table 1 and the bullets below present these results.

- **Share of facilities**. Steris's x-ray facilities (opened and announced) account for 3 of 28 U.S. x-ray or gamma facilities (10.7%)[89] and 11 out of 61 worldwide gamma or x-ray facilities (18.0%). Because x-ray facilities have greater capacity than gamma facilities, these counts understate the significance of Steris's x-ray facilities.
- **Share of facility bandwidth within Steris's network, based on carrier size**. Using capacity figures listed on Steris's website, Steris's three (open and announced) U.S. x-ray facilities have 70.1% as much capacity as its 11 gamma facilities, and its 11 worldwide x-ray facilities have 71.2% as much capacity as its 29 worldwide gamma facilities.[90]

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[81] STERIS AST, STERIS Kuala Ketil, Malaysia X-ray Operations Receive ISO 13485 Accreditations (July 12, 2023), https://www.steris-ast.com/news-and-events/news/steris-kuala-ketil-malaysia-x-ray-operations-recieve-iso-13485-accreditations.

[82] STERIS AST, STERIS Announces Completion of Suzhou, China Facility to Include X-ray Processing (Aug. 22, 2025), https://www.steris-ast.com/news-and-events/news/steris-announces-completion-of-suzhou-china-facility-to-include-x-ray-processing.

[83] STERIS AST, STERIS Announces New X-ray Processing Facility in Hochstadt, Germany (July 26, 2026), https://www.steris-ast.com/news-and-events/news/202607-steris-announces-new-x-ray-processing-facility-in-hochstadt-germany.

[84] STERIS AST, STERIS Announces New X-ray Processing Facility in The Netherlands (Feb. 20, 2023), https://www.steris-ast.com/news-and-events/news/steris-announces-new-x-ray-processing-facility-in-the-netherlands.

[85] STERIS AST, STERIS Announces New X-ray Processing Facility in Ireland (Feb. 22, 2022), https://www.steris-ast.com/steris-announces-new-x-ray-processing-facility-in-ireland/.

[86] Däniken, Libertyville, Venlo, Suzhou, Chonburi, and Kuala Ketil.

[87] Ontario, Chester, Tullamore, Venlo, and Hochstadt.

[88] I compared the current list of Steris facilities, available at https://www.steris-ast.com/our-locations, to the list of Synergy and Steris locations at the time of the merger as shown on archived copies of the parties' web sites.

[89] A smaller provider, SteriTek, has opened two U.S. x-ray facilities, in Fremont, CA (opened in 2016) and Lewisville, TX (opened 2022). If, as was true in 2015, the facilities of small providers primarily sterilize industrial materials and provide cross-linking services, SteriTek's facilities are unlikely to closely compete with those of Steris and Sterigenics.

[90] Steris's website lists each gamma location's carrier size and each x-ray facility's maximum pallet size, which I use as a proxy for a facility's total annual capacity. I assume that Steris's five announced but not-yet-opened facilities are comparable in capacity to its six existing x-ray facilities.

- **Share of total facility bandwidth, including competitors**. Assuming that Sterigenics's gamma facilities have the same average capacity as Steris's gamma facilities, Steris's opened or announced x-ray plants would constitute 23.7% of total U.S. x-ray/gamma capacity and 30.4% of worldwide x-ray/gamma capacity.[91]

Table 1: Estimated shares of Steris (open and announced) x-ray facilities[92]

U.S. gamma/x-ray sterilization

	Facilities (#)	Share of facilities	Total carrier/pallet size (cu. ft.)	Share of carrier size	Estimated capacity (cu. ft)	Share of capacity
Steris gamma	11	39.3%	639.3	33.6%	62,700,000	36.3%
Steris x-ray	3	10.7%	451.3	23.7%	22,564,339	13.1%
Sterigenics gamma	14	50.0%	813.7	42.7%	79,800,000	46.2%
Total U.S. gamma/x-ray	**28**		**1,904.2**		**172,564,339**	

Worldwide gamma/x-ray sterilization

	Facilities (#)	Share of facilities	Total carrier/pallet size (cu. ft.)	Share of carrier size	Estimated capacity (cu. ft)	Share of capacity
Steris gamma	29	47.5%	1,584.4	40.3%	208,800,000	45.4%
Steris x-ray	11	18.0%	1,195.8	30.4%	59,788,858	13.0%
Sterigenics gamma	21	34.4%	1,147.3	29.2%	151,200,000	32.9%
Total WW gamma/x-ray	**61**		**3,927.5**		**459,788,858**	

Sources: https://www.steris-ast.com/locations/; https://sterigenics.com/locations/.

Steris's x-ray facilities are successful. Steris's Venlo x-ray facility was "very well-received from a customer perspective" and had "significant positive margins within the first year of operation, which is not necessarily the norm."[93] Within three years of Venlo's opening, Steris announced plans to add a second x-ray processing line,[94] doubling its capacity. Steris would not have been incentivized to add a second processing line absent significant customer interest in Steris's Venlo x-ray facility.

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[91] Alternatively, assuming that Steris's x-ray facilities have the same 50,000 pallets/year capacity as does Sterigenics's gamma irradiator in Fort Worth, Steris's x-ray facilities account for approximately 15% of U.S. x-ray/gamma capacity, and 15% of worldwide capacity. Steris's website indicates that its Libertyville x-ray facility has a maximum pallet size of 451 cu. ft., for an annual capacity of 22.6M cu ft (22.6M – 451 * 50,000). This is approximately 15% of the estimated total U.S. demand for radiation sterilization of 150M cu. ft. (see McLean (Synergy) Transcript, 408:9-10). From Table 1, Steris's (open and announced) x-ray facilities have an estimated combined pallet size of 1,195.8 cu. ft., for a total annual capacity of 59.8M cu. ft. (59.8M = 1,195.8 * 50,000), or approximately 15% of total worldwide demand for radiation sterilization of 400M cu. ft. (see "A Comparison of Gamma, E-beam, X-ray and Ethylene Oxide Technologies for the Industrial Sterilization of Medical Devices and Healthcare Products," International Irradiation Association, August 2017, at 10, stating "In excess of 200 large-scale commercial gamma irradiators [] irradiate more than 400 million cubic feet of product annually.")

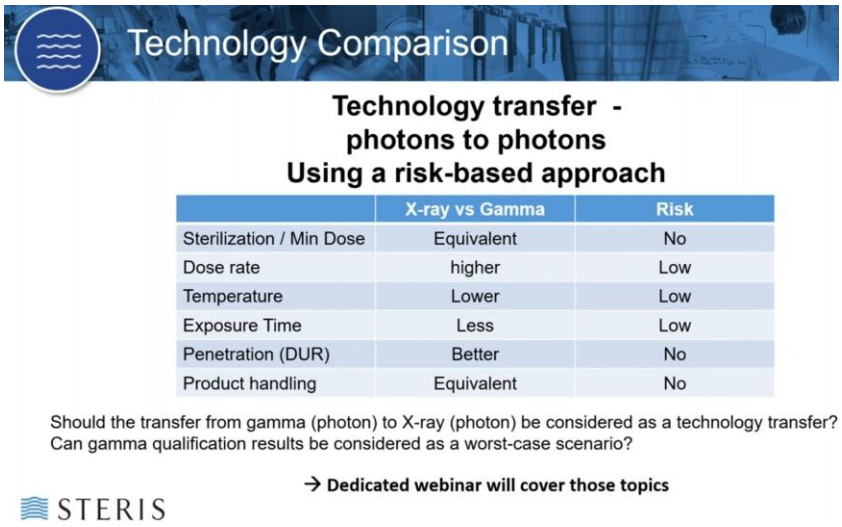
[92] **Table notes**. 1- Sterigenics's capacity is estimated to be proportional to Steris's based on number of facilities. 2- U.S. gamma capacity of 150 million cu. ft. is allocated to Steris and Sterigenics in proportion to number of facilities, with other firms having 5% of capacity. 3- Worldwide gamma capacity of 400 million cu. ft. is allocated to Steris and Sterigenics in proportion to number of facilities, with other firms having 10% of capacity. 4- Capacity of announced Steris x-ray facilities is assumed to be the same as Libertyville for U.S. locations and as the average capacity of Steris's five ex-U.S. x-ray facilities for ex-U.S. facilities.

[93] Steris 2023 Q1 earnings call.

[94] STERIS AST, STERIS Announces New X-ray Processing Facility in The Netherlands (Feb. 20, 2023), https://www.steris-ast.com/news-and-events/news/steris-announces-new-x-ray-processing-facility-in-the-netherlands.

Steris promotes x-ray. Steris has actively promoted x-ray over gamma and e-beam. Steris began marketing its sterilization business as "technology neutral" by March 2018.[95] In September 2020, a Steris presentation stated that "within Steris, we believe, and are confident that x-ray offers the most successful capacity on a like-for-like alternative scale."[96] In September 2020, Steris explained to customers that they faced "no" or "low" risk in each of six categories from switching products from gamma to x-ray (see Figure 1).[97] As Steris put it, "photons are photons. You'll find either no risk of a change between x-ray and gamma, or it's very little."[98]

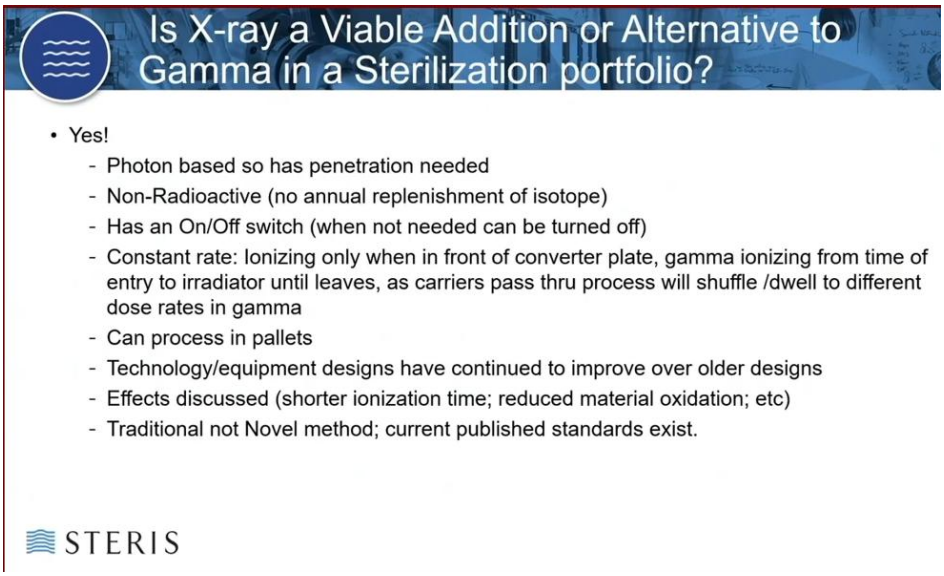
Figure 1: September 2020 Steris slide on transferring products from gamma to x-ray[99]



A May 2023 Steris presentation elaborated on the advantages of x-ray over gamma, explaining that (unlike e-beam) x-ray is photon-based and so has the same penetration as gamma; that x-ray is more controllable than gamma (because x-rays can be directed at a product whereas gamma rays are isotropic, or always on); that x-ray can process entire pallets (reducing turnaround time); and that x-ray can have fewer adverse effects on products.[100] Figure 2 displays a slide from this presentation.

[95] Steris 2018 Annual Report (reporting results through March 31, 2018), at 5 ("As a technology neutral service provider, we offer unbiased technology assessments dependent on the individual requirements of each product.").
[96] Steris, "Introduction to Industrial Sterilization for Medical Devices," September 8, 2020, around 26:10, available at https://www.youtube.com/watch?v=-ledNIWTjx0&ab_channel=STERISAppliedSterilizationTechnologies,.
[97] Steris, "Fundamentals of X-ray Irradiation Processing | Steris AST TechTalk," September 14, 2020, available at https://www.youtube.com/watch?v=os-gvk5qiYc&ab_channel=STERISAppliedSterilizationTechnologies.
[98] Steris, "Radiation Technology Transfer for Sterilization Processing," (around 32:20), available at https://www.youtube.com/watch?v=cUEIrYPdvNc&ab_channel=STERISAppliedSterilizationTechnologies.
[99] Steris, "Fundamentals of X-ray Irradiation Processing | Steris AST TechTalk," September 14, 2020 (around 20:30), available at https://www.youtube.com/watch?v=os-gvk5qiYc.
[100] Steris, "X-ray Sterilization Processing for Bioprocessing Products," available at https://www.youtube.com/watch?v=DpDi9eKRUu8&.

Figure 2: May 2023 Steris slide describing benefits of x-ray over gamma[101]



Steris's May 2023 presentation also described a widening gap between the demand for irradiation processing and the capacity of gamma sterilization, with the latter limited by the global supply of Cobalt-60. As the presentation put it, "they can't make enough cobalt fast enough, and it decays."[102] A Steris representative stated that x-ray is needed due to the ongoing growth in healthcare.[103]

Discussion. The evidence presented above does not establish that an independent Synergy would have replicated Steris's subsequent x-ray expansion. As discussed above, Steris benefited from assets and capabilities that Synergy lacked, including an established U.S. customer base and opportunities to co-locate x-ray facilities with existing sterilization operations. The retrospective evidence is therefore not a direct observation of the but-for world. It is informative about commercial viability and customer receptivity, not proof that Synergy would have replicated Steris's scale or timing. The evidence does, however, shed light on two questions central to the litigation: whether x-ray was commercially viable in the United States and whether Synergy's pre-merger plans to pursue x-ray expansion were credible. On both points, Steris's subsequent conduct tends to support the FTC's contemporaneous theory of the case.

B. Steris's revenue and margins have significantly increased since its 2015 Synergy acquisition

Data on pricing of sterilization services are not publicly available, so I am unable to determine whether Steris's prices increased post-merger, as might be expected from merging with a competitor.[104] I am aware of two data sources containing information on how Steris's pricing evolved post-merger, as described in detail below. First, Steris's and Synergy's annual financial reports indicate that the combined firm's margin increased by about 27% following the merger. Second, E-BEAM Services, a fringe U.S. e-beam provider, has periodically updated a blog post with estimates of the price of gamma; these prices

[101] *Id.*, around 28:30, available at https://www.youtube.com/watch?v=DpDi9eKRUu8&.
[102] *Id.*, around 27:00, available at https://www.youtube.com/watch?v=DpDi9eKRUu8&.
[103] *Id.*, around 25:50.
[104] Synergy was both a current and potential competitor to Steris. Synergy's U.S. e-beam facilities and its ex-U.S. gamma facilities competed with Steris's U.S. gamma facilities at the time of merger, and Synergy documents indicate that Synergy expected competition between Synergy's planned U.S. x-ray facilities and Steris's U.S. gamma facilities to constrain prices.

increased at an annual rate of 17.5% following the Steris/Synergy merger, suggesting significant increases in the price of gamma. I do not treat these data as independently identifying a merger effect; rather, I treat them as limited public evidence relevant to whether post-merger outcomes are consistent with the FTC's theory of reduced gamma/x-ray competition.

As described below, there are various potential explanations for Steris's higher sterilization margins and apparently higher prices for gamma following the merger. Steris's margin may have increased because its costs decreased, because demand increased, because the price of EO sterilization increased for reasons unrelated to gamma/x-ray competition (given that Steris reports a single margin for its entire sterilization business, including EO), or because of changes in product mix. However, as I will explain below, the available evidence on Steris's sterilization margin and the price of gamma is consistent with the FTC's theory that the merger would eliminate price competition between Steris and Synergy, even if not a dispositive indicator that the combined firm was able to raise prices because of increased market power.

Steris's sterilization margins. Financial filings from both before and after Steris's November 2015 acquisition of Synergy indicate that the combined firm's revenue increased following the merger at a faster rate than revenues were increasing pre-merger, with substantially all of the increase occurring from 2018-2022, before Steris's own x-ray expansion came online. The parties' combined pre-merger sterilization revenue grew at a compound annual growth rate (CAGR) of 8.2% during the pre-merger period, FY 2013-2015.[105] During the post-merger period, FY 2017-2024, Steris's revenue from its sterilization business increased at a CAGR of 10.0%.[106] On the other hand, the growth of the combined firm's operating costs slowed following the merger, growing at a pre-merger CAGR of 9.0% and a post-merger CAGR of 7.8%.[107] The combined firm's revenue and operating costs from 2013-2024 are plotted below in Figure 3.

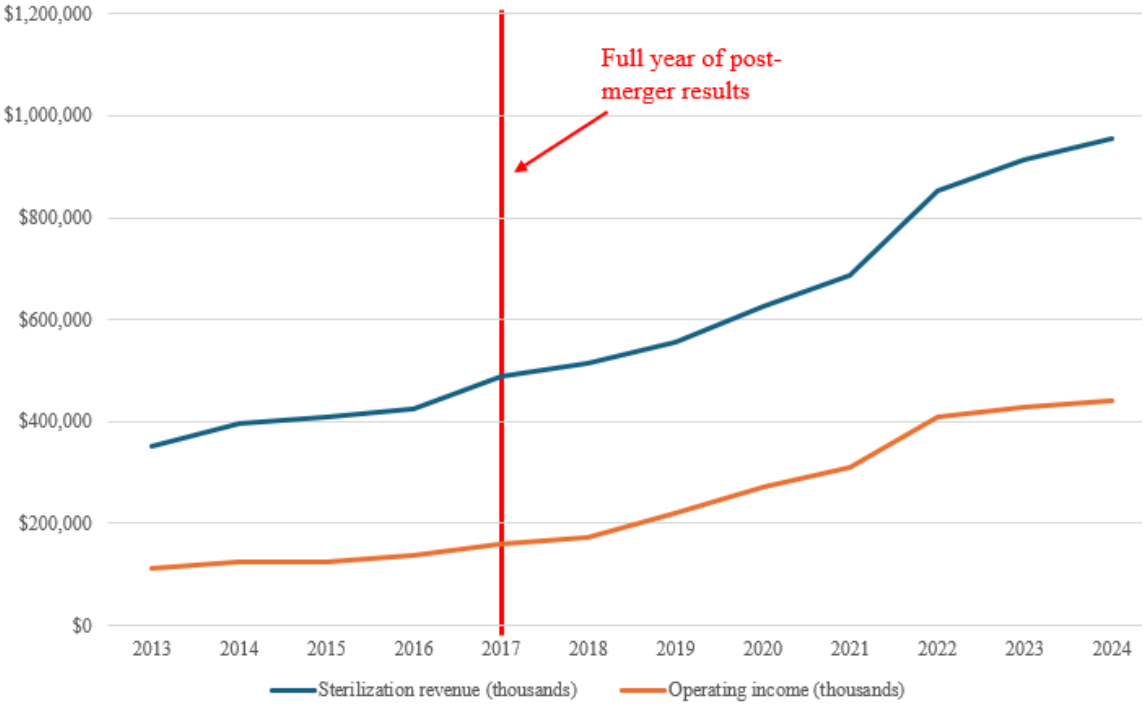
The combined firm's operating profit from sterilization—i.e., operating income as a fraction of revenue—markedly increased following Steris's acquisition of Synergy, from an average of 31.2% in the pre-merger years (FY 2013-2015), to an average of 39.5% in the post-merger years (2017-2024). The increase in Steris's margin appears to have begun in its FY 2018, i.e., the year beginning seventeen months following Steris's acquisition of Synergy. Figure 4 depicts the combined firm's operating margin from FY 2013-2024.

[105] 2013 was the first year reported revenues for both Steris and Synergy are available. 2015 was the final year for which the firms reported revenue separately. To track combined revenues, I obtained reported revenues from sterilization for both Steris and Synergy Health. For the pre-merger years, I sum Steris's reported revenue and Synergy's reported revenue, and for Steris FY 2016, ending 5 months after the closing of the acquisition, I imputed standalone Synergy's revenue for the first 7 months of the fiscal year as equal to 7/12 of its FY 2015. The CAGR is the rate of growth satisfying $(1 + CAGR)^N = \frac{Nth\ periuod\ value}{1st\ period\ value}$, where N is number of years. The fiscal years of both Steris and Synergy end in late March, e.g. FY 2024 ended March 31, 2024.

[106] 2017 was the first year in which Steris's financial filings fully reflected Synergy revenues. I tracked Steris's revenues from its AST (Applied Sterilization Technologies) division.

[107] From 2013-2018, Steris allocated certain corporate costs to its AST segment when reporting the segment's operating income. From 2019-2024, Steris removed these costs from reported operating income. To ensure comparability across the period 2013-2024, I have adjusted Steris's reported operating income from 2019 to 2024 downward by 9.8%, or Steris's 2018 allocated corporate costs as a percentage of Steris's 2018 operating income. Steris reported its 2018 operating income inclusive of these corporate costs in its 2018 Annual Report, and reported 2018 operating income *exclusive* of these costs in its 2019 Annual Report, which allows for the adjustment.

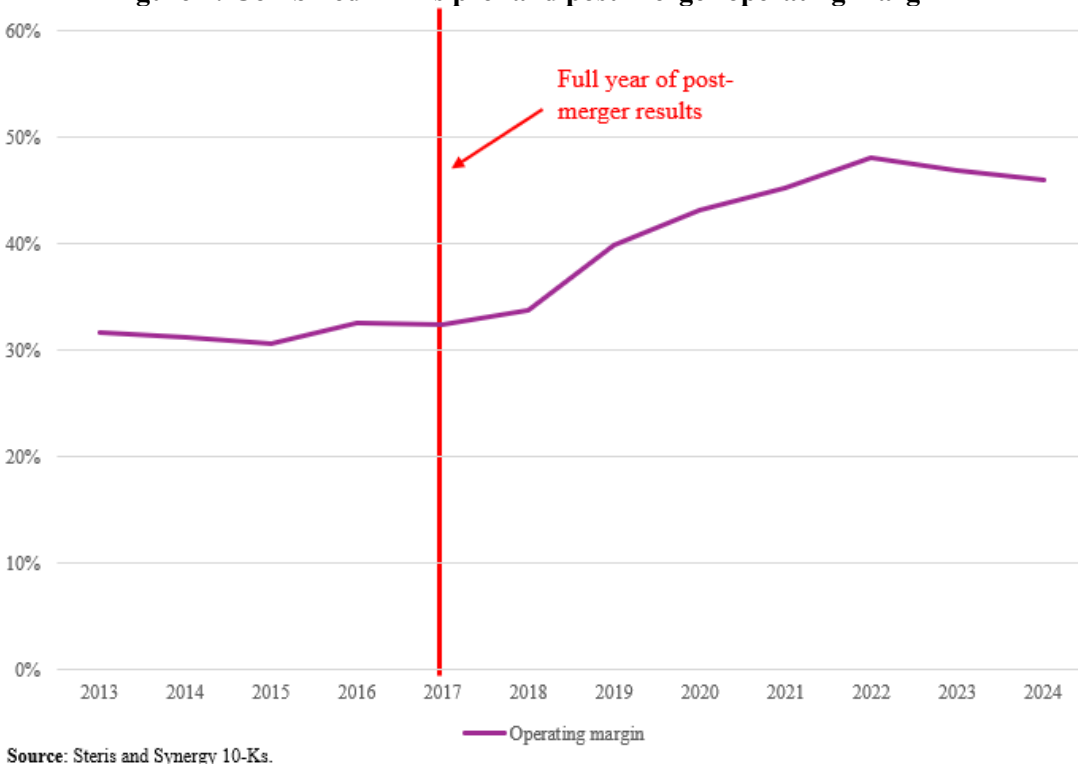
Figure 3: Combined firm's pre- and post-merger revenue and operating costs[108]



Source: Steris and Synergy 10-Ks.

[108] **Figure notes.** For 2013-2015 (the pre-merger period), I combine reported results for Steris and Synergy. In 2016, Steris reported results through March 31, the end of its fiscal year. As Steris's 2016 results reflect five months of Synergy financilas, following the November 2015 closing, to make 2016 comparable to other years, I allocated seven twelfths of Synergy's reported 2015 revenues and costs (the final year in which Synergy reported results) to Steris's 2016 numbers. From 2017-2024, results reflect the combined entity's results.

Figure 4: Combined firm's pre- and post-merger operating margin[109]



Source: Steris and Synergy 10-Ks.

Public information does not dispositively identify the causes of the increase in Steris's margin, or whether Steris's acquisition of Synergy contributed to the increase to any significant extent. As a matter of accounting, an increase in margin must be driven by either a decrease in costs or an increase in prices.[110] Either factor could, in theory, relate to the merger or it could be independent of the merger. I consider each factor separately, below.

Merger efficiencies are unlikely to explain Steris's increased margin. Steris projected only $2.5 million in synergies as a result of the transaction,[111] roughly 0.9% of the combined firm's pre-merger sterilization operating costs, enough to increase the combined firm's pre-merger margin from 30.7% (in 2015) to 31.3%.[112] The lack of attention paid to synergies during the trial[113]—suggests that synergies

[109] **Figure notes**. For 2013-2015 (the pre-merger period), I combine Steris and Synergy information to compute margin. In 2016, Steris reported results through March 31, the end of its fiscal year. As Steris's 2016 results reflect five months of Synergy financilas, following the November 2015 closing, to make 2016 comparable to other years, I allocated seven twelfths of Synergy's reported 2015 revenues and costs (the final year in which Synergy reported results) to Steris's 2016 numbers. From 2017-2024, results reflect the combined entity's results.

[110] One way that costs can decrease is if the mix of products sold shifts to lower cost, higher margin products. Synergy documents contemporaneous with the trial indicated that x-ray was likely to be lower cost than gamma, and thus it is possible that some of Steris's increase in margin resulted from a shift in mix towards x-ray. However, this is unlikely to account for the majority of the increase in Steris's margin, given that Steris's first x-ray facility following the Synergy acquisition (in Venlo, Netherlands) was not opened until 2022, well after the increase in Steris's margin.

[111] Roseborough (Steris) Transcript, 786:17-787:10.

[112] Steris and Synergy reported a combined $284.3 million in operating costs in FY 2015, or 69.3% of combined revenue (implying an operating margin of 30.7%). Reducing these costs by $2.5 million would have decreased costs to 68.7% of revenue, increasing the combined operating margin by 0.9%, to 31.3%.

[113] Synergies were discussed only briefly during the testimony of Steris CEO Walt Roseborough. See Roseborough (Steris) Transcript, 786:17-787:10.

significantly in excess of projections were unlikely, since the parties had every incentive to describe synergies as thoroughly as possible during the trial.

It is also unlikely that the merger resulted in unanticipated savings of sufficient magnitude to explain Steris's increase in margin. Both Steris and Synergy operated a large number of geographically-distributed sterilization facilities, making freight savings unlikely. Nor is a rationalization of facilities likely to have resulted in significant cost savings, given that Steris has not closed any gamma facilities since the merger.[114] Moreover, the costs of a single sterilization facility—e.g., the Cobalt-60 or accelerator needed to generate photons, and conveyor, warehousing, and shielding systems—are unlikely to depend on other facilities in a sterilizer's network.

Steris's increased margin is consistent with price increases. Steris does not publicly report pricing for its sterilization services. The one industry estimate of the price of gamma sterilization I am aware of comes from a small e-beam provider, E-BEAM Services, which has periodically updated a blog post describing its price for sterilizing boxes 6 inches in height as "competitive with gamma." The post listed that price as $1.60 per cubic foot on October 29, 2015[115] (four days before Steris closed its acquisition of Synergy) and as $4.20 per cubic foot beginning on October 21, 2021 (the last time the price was updated).[116] Taking the "competitive with gamma" price for a box with a height of six inches as a proxy for the contemporaneous price of gamma, the prices listed by E-BEAM Services imply a compound annual growth rate in the price of gamma sterilization of 17.5%,[117] well in excess of the growth rate of Steris's costs, as reported in its financial filings.

Some caution is warranted in interpreting the prices reported by E-BEAM Services, since, as described above, only a relatively small fraction (10-15%) of products that can be sterilized using gamma or x-ray are capable of being sterilized by e-beam, given that e-beam cannot penetrate nearly as well as gamma and x-ray. It is possible that the prices reported by E-BEAM Services relate only to the minority of products that *could* be sterilized using e-beam, and that such products are not representative of the larger set of products that need to be sterilized using gamma or x-ray, and thus price increases associated with products not suitable for e-beam could be higher or lower than those measured by E-BEAM Services.

While Steris has cited "favorable pricing" as a reason for increasing sterilization operating income in a recent financial filing (in 2024),[118] it has also described other causes of its increasing margin, including "organic growth and favorable fluctuations" (2022); "increased volume" offset by "higher labor and

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[114] To determine that Steris has not closed any gamma facilities, I compared the list of current Steris gamma facilities, available on Steris's website, to the list of Steris and Synergy gamma facilities at the time of the merger. They are identical.

[115] E-BEAM Services, What Is the Price of Electron Beam Radiation Sterilization, and How Does That Compare to Gamma? (archived Oct. 29, 2015), https://web.archive.org/web/20151029004747/https://ebeamservices.com/blog/price-electron-beam-radiation-sterilziation-compare-gamma/.

[116] E-BEAM Services, What Is the Price of Electron Beam Radiation Sterilization, and How Does That Compare to Gamma? (archived Oct. 21, 2021), https://web.archive.org/web/20211021173029/https://ebeamservices.com/blog/price-electron-beam-radiation-sterilziation-compare-gamma/. The blog had a price of $3.20 per cubic foot as recently as April 2021, indicating that E-BEAM Services saw $4.20 per cubic foot as a then-current price in October 2021. See https://web.archive.org/web/20210410212735/https://ebeamservices.com/blog/price-electron-beam-radiation-sterilziation-compare-gamma/.

[117] The CAGR is the rate of growth which, if applied to a 2015 gamma price of $1.60 would result in a 2021 price of $4.20. $4.20 = $1.60 * CAGR^6.

[118] Steris 2024 Annual Report, at 38.

energy costs" (2023); "higher volumes and reduced expenditures" (2021); "increased volumes" (2020); "increased volume" (2019 and 2018); and "the result of the combination [with Synergy], increased demand from core medical device Customers and operational efficiencies, including cost synergies" (2017).[119]

As an additional point of reference, Steris's chief competitor, Sterigenics, reported operating margins from sterilization of between 52% and 54% in each year from 2020-2024. Sterigenics was privately held prior to its fiscal year 2020 and did not publicly report financial results.

The evidence as to the causes of Steris's margin increase is not dispositive. The public data do not allow me to determine whether the increase reflected merger-related market power, industry-wide demand or capacity conditions, changes in product mix, scale or utilization effects, or other factors. The narrower point is that Steris's post-merger margin expansion, together with Steris's own references to favorable pricing and the limited E-BEAM Services evidence discussed above, is consistent with the FTC's theory that the merger would reduce competition and contribute to higher prices.

C. Synergy's contemporaneous x-ray financial model does not support trial testimony that x-ray had "woeful" returns

At trial, Synergy executives testified that the financial case for U.S. x-ray entry fell far short of the company's investment criteria. In particular, they testified that Synergy required a minimum 15% internal rate of return ("IRR") for major projects,[120] calculated over the first ten years of operation, and that the x-ray project yielded only about 6.5% under that methodology.[121] Executives further described the model as "woeful," speculative, and too underdeveloped to support approval.[122] Characterizations of the financial model were central to the parties' claims that Synergy's x-ray plan likely would not have gone forward even absent the merger: the term "IRR," referring to Synergy's projected internal rate of return on its planned x-ray expansion, was used 86 times at trial.[123] The contemporaneous model itself, however, does not appear to support so unequivocal a characterization.

Using information on model inputs and outputs described in the trial record and in Synergy documents, I replicate Synergy's financial model for its first two x-ray facilities, which it intended to locate in Texas and Indiana. The detailed replication methodology, assumptions, and sensitivity analyses are set out in Appendix II. In broad strokes, I use record evidence regarding expected prices, margins, capacity, utilization, capital expenditures, and years to profitability, and then calibrate remaining unknown inputs to match the outputs of the actual Synergy model described at trial. Although the public record does not permit exact reconstruction of Synergy's original spreadsheet, it does permit a reasonable approximation grounded in the available evidence and validated by its ability to reproduce the known outputs of the contemporaneous model. The point of the replication is not to show that entry was certain, but to test the narrower claim that Synergy's own model showed a project so weak that no rational firm would have proceeded.

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[119] Steris 2017 Annual Report, at 32; Steris 2019 Annual Report, at 32; Steris 2018 Annual Report, at 33; Steris 2020 Annual Report, at 30; Steris 2021 Annual Report, at 34; Steris 2022 Annual Report, at 36; Steris 2023 Annual Report, at 35.

[120] Testimony indicated that this threshold was lightly documented within Synergy, but executives testified that it was widely understood within the company; see Tyranski (Synergy) Transcript, 600:2-10.

[121] Hill (Synergy) Transcript, 735:25-739:12.

[122] Hill (Synergy) Transcript, 683:4-14.

[123] The term "IRR" appears 86 times in the 796 pages of the Transcript.

Table 2 summarizes my replication of Synergy's contemporaneous financial model. As Table 2 shows, the reconstructed model does not depict a financially hopeless project; it places the proposed expansion at or near Synergy's stated hurdle rate even under conservative assumptions. In particular, the replication implies that the project would yield an IRR of 14.5% when profits are evaluated over the approximately 25-year life of the facilities.[124] Synergy itself, using a related terminal-value approach, appears to have calculated an IRR of 15.85%.[125] Thus, by either calculation, the project appears to have been at or near Synergy's stated hurdle rate at the time of the September 2014 Senior Executive Board meeting, rather than far below the threshold needed to support further investment.

Table 2: Replication of Synergy's financial model for TX and IN x-ray facilities (combined)[126]

	Capital costs	Profit	Price/cu. ft.	Margin	Capacity utilization
2016	-$40,400,000	$343,000	$2.50	34.4%	0%
2017		$922,500	$2.50	34.4%	17%
2018		$2,535,000	$2.50	34.4%	33%
2019		$4,147,500	$2.50	34.4%	50%
2020		$5,760,000	$2.50	34.4%	67%
2021		$6,802,750	$2.50	34.4%	83%
2022		$7,609,000	$2.50	34.4%	100%
2023		$7,609,000	$2.50	34.4%	100%
2024		$7,609,000	$2.50	34.4%	100%
2025		$7,609,000	$2.50	34.4%	100%
2026		$7,609,000	$2.50	34.4%	100%
2027-2041		>$7,609,000	>$2.50	34.4%	100%
IRR, 2016-2041		**14.50%**	(2016-2041 was approximate facility lifespan)		
IRR, 2016-2025 only		**6.51%**	(matches Synergy calculation)		
IRR, 2016-2025 + TV		**15.85%**	(matches Synergy calculation)		

The trial record suggests that several features of Synergy's model were conservative. Most importantly, the model appears to have assumed that x-ray would be priced at a substantial discount to gamma and that

[124] Synergy itself modeled the x-ray accelerator as having a 20-year lifespan and the building and conveyor system associated with an x-ray plant as having a 30-year lifespan. See Hill (Synergy) transcript, 741:20-742:4.

[125] The terminal value calculation used by Synergy appears to set the terminal value of each x-ray facility to its year-10 profit flow, divided by a discount rate minus a rate of growth, or $TV = \frac{year\ 10\ profit}{discount\ rate - growth\ rate}$. The trial record indicates that the calculation used a 2% growth rate, consistent with Synergy's publicly-disclosed "perpetuity growth rate" of 2%. The discount rate that results in an IRR (including terminal value) of 15.85% is 11.9%. This discount rate is well above Synergy's publicly-announced pre-tax discount rate of 7.9%, possibly reflecting perceived additional risk associated with x-ray. See Synergy 2015 Annual Report, at 81 for the pre-tax discount rate and the perpetuity growth rate of Synergy's AST segment.

[126] **Table notes**: 1- The methodology used to determine model inputs is explained in Appendix II. 2- Profit = Price/cu. ft. * Margin * Capacity utilization * Capacity - Fixed costs. 3- The "Capacity utilization" column depicts volume divided by capacity at Synergy's TX facility, with its OH have greater utilization due to pre-existing volumes shifting from Synergy's Lima e-beam facility. 4- "TV" refers to "terminal value," or the calculation in Synergy's model to account for profits generated by x-ray facilities more than ten years out. Synergy calculated a terminal value assuming profits would grow at 2% per annum in perpetuity. I calibrate the discount factor used to match Synergy's calculation of a 15.85% IRR. This discount value is 11.9%.

this discount would persist for years, despite evidence that x-ray offered technical and operational advantages and despite later market evidence that Steris itself successfully expanded x-ray capacity.[127] As I show in the appendix, allowing x-ray prices to rise over time toward gamma prices materially increases the IRR predicted by the model.

Further, by late February 2015, the dollar had appreciated against the euro in a way that lowered the projected cost of the x-ray accelerators by roughly $1 million per facility, raising the project's IRR above 15% even without any further change in operating assumptions.[128] Thus, the contemporaneous record suggests that the project's economics had improved, not deteriorated, by the time Synergy abandoned it.

The appendix shows that other economically plausible modifications to the model also increase the project's projected return, often materially. These include: 1) Allowing x-ray prices to increase relative to gamma prices over time; 2) Allowing margins to increase as prices rise; 3) Accounting for the value of x-ray facilities beyond the ten-year window repeatedly referenced in Synergy's trial testimony; 4) Accounting for the implicit discount on a Euro-denominated accelerator as the USD-EUR exchange rate improved; and 5) Accounting for revenues that Synergy planned to move over from its end-of-life facility in Lima, OH. Each such modification improves the IRR, relative to the version of the model that was the subject of Synergy's trial testimony.

Table 3 summarizes the principal scenarios considered in Appendix II. Across those scenarios, the baseline model is at or near Synergy's stated 15% threshold even under conservative assumptions, and modest changes generally push the projected IRR materially above that level. Indeed, in one important respect—the exchange-rate movement that lowered projected capital costs—the project's financial prospects actually appear to have improved by February 2015, when it was terminated, relative to September 2014, when it was presented internally for approval. The point is not that any single alternative assumption is obviously correct, but that the trial testimony presented the model as materially weaker than it appears to have been under Synergy's own framework.

The financial model does not prove that Synergy certainly would have entered with x-ray absent the merger. But it does indicate that the project was at least plausibly viable by Synergy's stated standards and that testimony portraying the model as "woeful" materially overstated the weakness of the business case for entry. That conclusion matters because the district court's probability analysis relied heavily on the premise that Synergy's own financials showed the project to be uneconomic.[129] Properly understood, the model does not show certainty of entry, but it is consistent with a serious and financially plausible expansion plan whose abandonment is difficult to explain solely by reference to poor economics.

[127] See section III.A.

[128] On September 20, 2014, the USD:EUR exchange rate was 1.2829. On March 7, 2015, it was 1.0844. Synergy projected the cost of an x-ray accelerator to be EUR 5.174 million, which was equal to $6.6 million in September 2014 and $5.6 million in March 2015. See Tyranski (Synergy) Transcript, 633:13-15 (stating that Synergy modeled the x-ray accelerators to cost EUR 5.174 million).

[129] The district court cited the project's IRR as evidence that the x-ray business model "failed every one of the metrics Synergy uses to rank capital investments" (Decision, at 35) and noted that "the PLC board generally will not approve funding a discretionary capital investment without an IRR of 15%." (Decision, at 35-36). In the district court's view, the financial model approved by the SEB in September 2014 required "an effort to develop a financial model that more accurately represented the economic realities," and in the course of this effort, "the numbers got worse instead of better." (Decision, at 35).

Table 3: Internal rate of return of Synergy financial model under various scenarios

Capex	IRR	Price of x-ray	IRR
Baseline: $20.2 million per facility	14.5%	Baseline: $2.50 per cu. Ft.	14.5%
↓ $1 million from stronger dollar	15.2%	↑ 2%/yr, to $3/cu. ft. in 2026	16.7%
↓ $1.5 million (Synergy's goal)	15.5%	↑ 5%/yr, to $4/cu. Ft. in 2026	17.6%
Synergy margin		**Lima revenues**	
Baseline: 34.4% margin	14.5%	Baseline: Lima revenues to IN	14.5%
↑ 2%/yr (match Steris 2025 margin)	16.7%	↓ Remove Lima revenues	12.8%
Terminal value		**Rate of volume growth**	
Baseline: 25-year facility life, no TV	14.5%	Baseline: 6 yrs to fill capacity	14.5%
Synergy TV calculation	15.9%	↓ 10 yrs to fill capacity	12.2%
Medium upside scenario		**High upside scenario**	
Capex ↓ $1M, 6 yrs to fill capacity, price ↑ 2%/yr, Lima revenues to IN	17.4%	Capex ↓ $1M, 6 yrs to fill capacity, price ↑ 5%/yr, margin ↑ 2%/yr	21.4%
Downside scenario			
Baseline capex, price, and margin, no Lima, 10 yrs to fill capacity	10.2%		

IV. Potential Competition Doctrine

A. Existing doctrine and a probability-centric approach to potential competition

The antitrust treatment of potential competition traces back more than sixty years and centers on a recurring question: was one of the merging firms likely to have entered the target market independently, such that the merger eliminates the competitive benefits of that entry? As the cases discussed below show, the doctrine has developed in a way that places substantial weight on the likelihood of entry, while leaving less clear how courts should account for the competitive significance of entry if it occurs.

Potential competition doctrine has traditionally encompassed two related but distinct theories. In *actual potential competition* matters, the concern is that a merger eliminates a firm that likely would have entered the market independently and competed against incumbent firms. In matters involving *perceived potential competition*, the concern is that the mere possibility of entry by an outside firm may constrain incumbent conduct, even if entry never ultimately occurs. Although the two theories differ in their mechanisms, both are rooted in the idea that firms outside a market can affect competition within it. While both varieties are relevant to understanding *Steris*, that matter involved an actual potential competition theory, given the FTC's allegation that Synergy was planning to enter the U.S. radiation sterilization market using x-ray, in competition with Steris. As discussed below in Section V, the economic significance of actual potential competition depends on both the likelihood that entry would occur and the competitive consequences that would follow if it did. Although this article focuses primarily on actual potential competition, a similar intuition applies to perceived potential competition, since the degree to which incumbents are constrained depends on their assessment of both the likelihood and competitive significance of future entry.

The Supreme Court first recognized the competitive significance of potential entry in *United States v. El Paso Natural Gas Co.* (1964). There, the Court considered El Paso's acquisition of Pacific Northwest Pipeline, then the only other major interstate pipeline positioned to challenge El Paso in California.[130]

[130]United States v. El Paso Natural Gas Co., 376 U.S. 651 (1964).

Pacific Northwest had not yet entered, but it had repeatedly tried to do so, including through negotiations with a major potential customer.[131] The Court reversed the district court's dismissal of the government's complaint, explaining that Pacific Northwest's competitive significance did not depend on its completed entry: its presence as a potential supplier "made it a substantial competitive factor" in the market, and "unsuccessful bidders are no less competitors than the successful one."[132]

El Paso is important because it treated potential entry as competitively meaningful even without completed or certain entry. The Court's emphasis was not simply on whether Pacific Northwest would succeed, but on the competitive discipline created by its efforts and position at the edge of the market. That framing is consistent with the intuition behind an expected value approach, under which the importance of forgone entry depends on both the likelihood of entry and the significance of its effects if realized.

Procter & Gamble also reflected concern with the elimination of a powerful potential entrant, though the decision is often classified more broadly as an entrenchment or perceived potential competition case. That matter involved the acquisition of Clorox, the dominant producer of liquid bleach, by Procter & Gamble, a large manufacturer of household products.[133] The Court upheld the FTC's finding that the acquisition eliminated P&G as the most likely potential entrant into the bleach market, finding it "amply supported by the evidence."[134] The opinion rested in part on a "perceived potential competition" theory: smaller bleach producers had been disciplined by the threat that P&G might enter the market on its own, and the merger removed that threat, enabling the combined firm to exercise greater market power.[135]

Penn-Olin extended the doctrine and more explicitly recognized the competitive value of firms "waiting in the wings." In *United States v. Penn-Olin Chemical Co.* (1964), the Court rejected the view that the government had to prove both parents would have entered independently absent their joint venture.[136] Even if only one had entered, the other could still matter competitively by remaining on the market's periphery and "continually threatening to enter."[137] The Court remanded for an inquiry into whether there was a "reasonable probability" that one firm would have entered while the other remained a significant potential competitor.[138] *Penn-Olin* is thus notable for recognizing that uncertain entry can still have meaningful competitive value.

Falstaff moved the doctrine toward a more structured inquiry into likely entry, though it still retained a concern with competitive effects. In *United States v. Falstaff Brewing Corp.* (1973), the Court considered Falstaff's acquisition of Narragansett, the largest beer seller in New England.[139] Falstaff, the nation's fourth-largest brewer, sought to expand into the New England market but its management had concluded that entry was feasible only through acquisition. The Court rejected the district court's reliance on management's testimony that de novo entry was not planned and instead asked whether Falstaff was "so positioned on the edge of the market that it exerted beneficial influence on competitive conditions."[140]

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[131] *Id.* at 659.
[132] *Id.* at 661 ("Unsuccessful bidders are no less competitors than the successful one.").
[133] FTC v. Procter & Gamble Co., 386 U.S. 568 (1967).
[134] *Id.* at 580–81.
[135] *Id.* at 578.
[136] United States v. Penn-Olin Chemical Co., 378 U.S. 158 (1964).
[137] *Id.* at 174 ("Potential competition … as a substitute for actual competition may restrain producers from overcharging those to whom they sell or underpaying those from whom they buy.").
[138] *Id.* at 176.
[139] United States v. Falstaff Brewing Corp., 410 U.S. 526 (1973).
[140] *Id.* at 532–33.

That formulation preserved the idea that firms can matter before entry occurs, but it also focused the analysis more sharply on whether market participants would view the firm as a genuine entrant.[141]

Falstaff is significant for two related reasons. First, the Court distinguished between an acquiring firm's subjective statements about entry and the objective market conditions bearing on whether it constitutes a meaningful potential competitor.[142] That distinction matters here because the Steris court placed substantial weight on Synergy executives' testimony about the weakness of the x-ray project. Second, *Falstaff* proceeded on a perceived potential competition theory, under which incumbents may moderate their conduct because they view the acquiring firm as a likely entrant. At the same time, the Court expressly reserved whether actual potential competition—i.e., the loss of entry that would in fact have occurred—independently supports a Section 7 claim.[143]

The following year, in *United States v. Marine Bancorporation, Inc.* (1974), the Court articulated the most structured version of the potential competition framework in addressing a proposed merger between two commercial banks in Washington State.[144] The government challenged the merger on both perceived and actual potential competition grounds, and the Court acknowledged that the loss of the procompetitive effects of perceived potential entry "may render a merger unlawful under § 7."[145] But it also required several predicates, including a concentrated target market, an acquirer among the few firms capable of entry, and a substantial likelihood that such entry would deconcentrate the market.[146] Because the state of Washington's regulatory regime sharply constrained bank expansion, the Court found no feasible path by which the acquiring firm could have entered the market.[147] The decision thus reinforced the importance of entry feasibility and likelihood, even while leaving unresolved whether actual potential competition alone is a valid Section 7 theory.

Marine Bancorporation is the decision most directly relied upon by the Steris court.[148] It supplied the most detailed doctrinal framework for analyzing potential competition claims and, critically, left unresolved whether the actual potential competition doctrine—under which a merger is unlawful because it eliminates the acquiring firm as a *de facto* future entrant—constitutes a valid basis for a Section 7 claim.[149] The result is a doctrine that is both highly structured and incomplete: structured because it emphasizes concentration, capability, and feasibility of entry, but incomplete because it never squarely resolves how courts should assess the competitive significance of forgone entry when that entry is uncertain.

Taken together, the foundational potential competition cases identify several recurring considerations: market concentration, whether one of the merging firms was plausibly positioned to enter, and whether the merger eliminates the competitive benefits associated with that potential entry. What varies across the cases is the evidentiary threshold for treating entry as sufficiently likely to matter. Over time, that threshold appears to have risen, from *El Paso*'s broader concern with competitive significance, through

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[141] *Id.* at 533.
[142] *Id.* at 534 n.13 ("The specific question with respect to this phase of the case is not what Falstaff's internal company decisions were but whether, given its financial capabilities and conditions in the New England market, it would be reasonable to consider it a potential entrant into that market.").
[143] *Id*.
[144] United States v. Marine Bancorporation, Inc., 418 U.S. 602 (1974).
[145] *Id.* at 625.
[146] *Id.* at 623–30.
[147] *Id.* at 633.
[148] The Steris court applied a standard drawn from *Marine Bancorporation* and required the FTC to show that Synergy "probably" would have entered the U.S. market but for the merger. Decision, at 19.
[149] *Id.* at 624–25. The Court reserved the question of whether the "actual potential competition" theory—under which the concern is that de novo entry would have occurred but for the merger—was a valid basis for a Section 7 claim. The Court has never definitively resolved this question.

Falstaff's focus on perceived entry, to *Marine Bancorporation*'s more elaborate and feasibility-oriented framework.

The common thread, however, is that courts have increasingly framed the analysis around the *probability* of entry. Once that probability is found to be low, the inquiry may end without a separate assessment of the magnitude of competitive benefit that entry, if it occurred, would bring about. This is the central tension motivating the expected value approach. Economically, the competitive significance of potential entry depends on both the likelihood and the magnitude of its effects.[150] An entrant with a relatively low probability of entry but a transformative competitive impact may generate expected benefits comparable to, or greater than, an entrant that is very likely to enter but would have only a modest competitive effect. By treating probability as a gatekeeping threshold, rather than as one input into a broader assessment, courts risk undervaluing the loss of uncertain but potentially consequential entry.[151]

None of the foundational cases explicitly required that entry be "more likely than not." *Penn-Olin*, for instance, instructed the trial court to assess whether there was a "reasonable probability" of entry, a standard that need not imply a greater-than-fifty-percent threshold.[152] In practice, however, the combination of a probability-centric framework and the government's burden of proof has made potential competition cases difficult to win when the likelihood of entry is uncertain. The *Steris* court's decision to frame the case around whether Synergy "probably" would have entered[153]—without separately assessing the magnitude of the competitive effects of such entry—is one plausible extension of this doctrinal trajectory.

One possible explanation for the relative scarcity of litigated potential competition cases following Marine Bancorporation is the probability-centric approach to potential competition matters that evolved over the course of the cases discussed above. Future entry is inherently uncertain, and it may be difficult to demonstrate prospectively that entry is more likely than not to occur. To the extent courts require a showing of likely entry before giving substantial weight to the competitive benefits that entry would create, the doctrine may systematically disfavor challenges involving uncertain but potentially important entry. Whether or not this helps explain the limited number of litigated cases, it highlights a central limitation of the probability-centric framework and motivates the expected value approach developed below.

This article does not assess whether Steris was correctly decided as a matter of law. The narrower point is that the probability-centric approach adopted in Steris was consistent with one plausible reading of existing potential competition doctrine, but was not clearly compelled by that doctrine. The cases discussed above establish that potential competition can be competitively significant and that courts must assess the likelihood of independent entry. They do not, however, clearly require a binary rule under which a merger is lawful whenever entry falls below a "probable" threshold, without regard to the magnitude of the competitive effects that successful entry would have produced. Steris therefore fits

[150]B. Douglas Bernheim, "The Effects of Third-Party Entry on Competition in a Strategic Setting," *RAND Journal of Economics* 15(4): 539–50 (1984). See also Richard J. Gilbert & David M.G. Newbery, "Preemptive Patenting and the Persistence of Monopoly," *American Economic Review* 72(3): 514–26 (1982).
[151]See *Marine Bancorporation*, 418 U.S. at 639 (White, J., dissenting) ("The Court's treatment of these issues is at odds with the purposes underlying § 7.").
[152]See, e.g., the *Penn-Olin* Court's enumeration of factors relevant to assessing the probability of a substantial lessening of competition, which included "an appraisal of what the competition in the relevant market would have been if one of the joint venturers had entered it alone." 378 U.S. at 176–77.
[153] Decision, at 7 ("the court directed counsel to focus their attention at the hearing on [] whether, absent the acquisition, the evidence shows that Synergy probably would have entered the U.S. contract sterilization market by building one or more x-ray facilities within a reasonable period of time.").

within one strand of the precedent, but the earlier cases left room for an alternative approach that gives greater weight to the competitive significance of entry conditional on its occurring.

B. Modern merger challenges and the treatment of uncertain entry

The foundational potential competition cases discussed above were decided in the 1960s and 1970s, and the doctrine lay largely dormant for decades. *Steris* in 2015 was the first litigated potential competition challenge in more than thirty years.[154] Since then, agencies have brought or threatened a number of related cases. These modern cases show both the renewed importance of potential competition theories and the continuing pull of a probability-centered framework that sits uneasily with the expected value approach I propose in this paper.

FTC v. Meta/Within (2023). The FTC's challenge to Meta's acquisition of Within, developer of the VR fitness app Supernatural,[155] was the most significant litigated potential competition case since *Steris*. The FTC alleged that Meta—already the dominant supplier of VR headsets and operator of a widely-used VR app store—was the most likely independent entrant into VR-dedicated fitness apps, and that acquiring Within would eliminate both the disciplining effect of Meta's presence on the edge of the market and the competitive benefits of Meta's own de novo entry. The case thus presented both perceived and actual potential competition theories.

The court denied the FTC's request for a preliminary injunction, notwithstanding its acceptance of the FTC's proposed market for VR-dedicated fitness apps.[156] The most important aspect of the decision for present purposes was its interpretation of "reasonable probability." Rather than treating that phrase as a flexible inquiry into whether Meta's entry was sufficiently likely and competitively important to matter, the court interpreted it to require a showing that entry had a "better than fifty percent chance of occurring."[157] That formulation made explicit what *Steris* had left largely implicit: under a probability-centric approach, the government must show not merely that entry was plausible, competitively significant, or worth considering in expected value terms, but that it was more likely than not to occur. It also sharpened the probability-centric structure of the analysis: unless the FTC could show that Meta more likely than not would have entered de novo, the actual potential competition claim failed before the court separately considered how competitively significant Meta's entry would have been if it occurred.

The FTC's case nonetheless failed on the facts. The court found that Meta lacked the specific capabilities needed to develop a VR fitness app independently, particularly the content production capabilities required to create filmed workout content, and that the FTC had not established likely de novo entry absent the acquisition.[158] The court also found insufficient evidence that Meta's perceived presence on the edge of the market had constrained Within or other market participants.[159]

From the vantage point of the expected value framework, *Meta/Within* illustrates the limitations of a probability-centric standard. The court's analysis focused primarily on whether Meta had a "better than 50% chance" of entering the VR fitness market. It did not separately assess the magnitude of competitive effects that such entry would have produced. In that respect, the case extends the concern raised by *Steris*: by treating probability as a threshold requirement rather than as one input into a broader assessment of expected harm, the analysis could not distinguish between a merger that eliminates high-probability but

[154]Complaint, *supra* note 21.
[155]FTC v. Meta Platforms Inc., No. 5:22-cv-04325-EJD (N.D. Cal. Feb. 3, 2023) (order denying preliminary injunction).
[156]*Id.*, slip op. at 37–39.
[157]*Id.*, slip op. at 42.
[158]*Id.*, slip op. at 47–55.
[159]*Id.*, slip op. at 55–60.

low-impact entry and one that eliminates lower probability but high impact entry.[160] That distinction matters because the expected value of lost entry turns on both variables. A 40% chance of entry with large competitive effects may be more important than a 70% chance of entry with only modest effects, but a better-than-50% threshold treats the former as categorically insufficient and the latter as potentially actionable.

DOJ v. Visa/Plaid (2020–2021). The Department of Justice's (DOJ's) challenge to Visa's proposed acquisition of Plaid illustrates potential competition concerns in a setting dominated by a powerful incumbent.[161] Visa supplied more than 70% of U.S. online debit transactions, while Plaid—though primarily a financial data platform—was developing a payments product that could have allowed consumers to bypass Visa's debit network.[162] DOJ alleged that the acquisition would eliminate the emerging threat before Plaid's product reached market. Internal Visa documents described the acquisition as an "insurance policy" against what executives viewed as a significant threat to Visa's debit business.[163]

Visa abandoned the merger before trial,[164] so the case produced no judicial ruling on the merits. It nonetheless illustrates an important feature of the expected value approach. The probability that Plaid would have successfully launched a competing debit product was uncertain, given that the product was still under development and that entry into payments processing faces significant network effects and regulatory hurdles. Under a strict probability-threshold standard, this uncertainty could have worked in Visa's favor. But the expected competitive significance of successful entry may have been substantial. At least as alleged by DOJ, Plaid's product threatened a highly concentrated and lucrative payments network in which even partial displacement of Visa's debit transactions could have had meaningful competitive consequences. Visa/Plaid therefore illustrates why probability alone can be an incomplete screen. Even if Plaid's eventual success was uncertain, the magnitude of the competitive threat alleged by DOJ made the lost entry potentially important in expected value terms.

FTC v. Sanofi/Maze (2023). The FTC's challenge to Sanofi's exclusive licensing agreement with Maze applied the potential competition framework to pharmaceuticals.[165] Sanofi was the monopoly supplier of approved Pompe disease treatments, while Maze had developed an oral therapy in Phase 2 clinical testing that, if approved, would have offered a substantially different and potentially more attractive treatment

[160] See also Google/DoubleClick, which involved an at least superficially similar fact pattern to *Meta/Within* but which the FTC allowed to go through without a challenge. At the time of the merger, Google was developing an ad server product that would have competed with DoubleClick. A majority of the Commission concluded that "there is no evidence that Google's developmental product is unique relative to existing third party ad servers, nor is the evidence clear that Google is certain to be successful in winning customers for those products," seemingly viewing a high probability of entry and success as necessary for a merger challenge. The Commission also concluded that had Google entered independently, its entry would not have generated significant competitive benefits, given that ad servers were already a "commodity good" that was already competitive. See Statement of Federal Trade Commission Concerning Google/DoubleClick. However, see also Commissioner Harbour's dissenting statement, in which she expressed a view that "[i]t is difficult to believe that Google [] would have been unable to refine its beta product and release a highly competitive third party ad serving solution of its own" which would have benefitted "ad serving customers [through] both price and innovation competition;" Dissenting Statement of Commissioner Pamela Jones Harbour, In the matter of Google/DoubleClick.

[161] Complaint for Temporary Restraining Order and Preliminary Injunction, United States v. Visa Inc., No. 3:20-cv-07810 (N.D. Cal. Nov. 5, 2020) ("Visa/Plaid Complaint").

[162] *Id.* at ¶¶ 3–4.

[163] *Id.* at ¶ 7 (quoting Visa CEO Al Kelly's description of the acquisition as an "insurance policy").

[164] U.S. Dep't of Just., Visa and Plaid Abandon Merger After Antitrust Division's Suit to Block (Jan. 12, 2021), https://www.justice.gov/archives/opa/pr/visa-and-plaid-abandon-merger-after-antitrust-division-s-suit-block.

[165] In the Matter of Sanofi; Maze Therapeutics, Inc., FTC Docket No. 9426, Complaint (Dec. 11, 2023).

option. The FTC alleged that Sanofi's acquisition of worldwide rights to Maze's drug would "eliminate a nascent competitor poised to challenge Sanofi's monopoly."[166]

Sanofi terminated the licensing agreement on the same day the FTC authorized its complaint, so the case was never litigated.[167] Still, the FTC's willingness to challenge the transaction is notable because Maze's product was still in early-stage development, making successful commercialization uncertain.[168] Under a probability-threshold approach, that uncertainty would weigh heavily against intervention. Under an expected value approach, however, the calculus may differ: Sanofi's monopoly position, the high cost of existing treatment ($750,000/year), and the potential significance of an oral alternative suggest that even a modest chance of successful entry could carry substantial competitive value.[169]

FTC v. Edwards Lifesciences/JenaValve (2025). The FTC's challenge to Edwards's proposed acquisition of JenaValve presents a related but distinct theory of harm: the elimination of head-to-head innovation competition between pipeline products.[170] After acquiring JC Medical, Edwards sought also to acquire JenaValve, the only other firm with an ongoing U.S. trial for a TAVR-AR device intended to treat aortic regurgitation, a serious and potentially fatal heart condition.[171] The FTC alleged that the combined effect would be to place under common ownership the only two firms actively racing to develop products for that indication.[172] In January 2026, the district court granted the FTC's motion for a preliminary injunction,[173] at which point Edwards and JenaValve abandoned their proposed merger.[174] The court emphasized that Edwards and JenaValve were the only two firms in the United States with TAVR-AR devices in clinical trials and found a reasonable probability of a Section 7 violation because the transaction would eliminate the "vigorous competition" in which the two firms currently engaged.[175]

The FTC's complaint emphasized that competition between Edwards/JC Medical and JenaValve was accelerating development and improving expected clinical outcomes, and that the acquisition would eliminate that rivalry.[176] Unlike *Steris*, *Meta/Within*, or *Visa/Plaid*, the concern was not simply foreclosed entry into an existing market, but the loss of innovation competition between firms racing to create the market. That distinction matters. In Steris and Meta/Within, the courts asked whether the allegedly eliminated entrant probably or reasonably probably would have entered. In Edwards/JenaValve, by contrast, the competitive relationship was already observable in the firms' parallel development efforts, even though commercial sales remained contingent on future FDA approval. Even so, the case fits

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[166]Fed. Trade Comm'n, FTC Seeks to Block Sanofi's Acquisition of Rare Disease Drug that Threatens Sanofi's Monopoly (Dec. 11, 2023), https://www.ftc.gov/news-events/news/press-releases/2023/12/ftc-seeks-block-sanofis-acquisition-rare-disease-drug-threatens-sanofis-monopoly.

[167]Fed. Trade Comm'n, Statement Regarding the Termination of Sanofi's Proposed Acquisition of Maze Therapeutics' Pompe Disease Drug (Dec. 13, 2023), https://www.ftc.gov/news-events/news/press-releases/2023/12/statement-regarding-termination-sanofis-proposed-acquisition-maze-therapeutics-pompe-disease-drug.

[168] In the Matter of Sanofi; Maze Therapeutics, Inc., FTC Docket No. 9426, Complaint (Dec. 11, 2023).

[169] *Id*.

[170]In the Matter of Edwards Lifesciences Corp.; JenaValve Technology, Inc., FTC File No. 241-0115, Complaint (Aug. 6, 2025).

[171] *Id.*

[172] *Id.*

[173] *FTC v. Edwards Lifesciences Corp., No. 1:25-cv-02569-RC, slip op. (D.D.C. Jan. 28, 2026) (redacted memorandum opinion and order granting preliminary injunction).*

[174] Edwards Lifesciences, Edwards Comments on JenaValve Acquisition, Jan. 9, 2026, https://ir.edwards.com/news/news-details/2026/Edwards-Comments-on-JenaValve-Acquisition/default.aspx

[175] *FTC v. Edwards Lifesciences Corp., No. 1:25-cv-02569-RC, slip op. (D.D.C. Jan. 28, 2026) (redacted memorandum opinion and order granting preliminary injunction).*

[176]*Id.* (alleging that Edwards' acquisition of JenaValve would combine the only two companies with ongoing U.S. clinical trials for TAVR-AR devices).

naturally within an expected value framework: although it is uncertain whether both firms would independently obtain FDA approval, the expected value of preserving rivalry between them—in terms of faster development, better outcomes, and lower eventual prices—may still be substantial. The decision strengthens that point by showing that uncertainty about ultimate FDA approval did not prevent the court from treating present innovation rivalry itself as competitively meaningful.

These modern cases reflect a consistent pattern. Agencies are increasingly willing to challenge transactions that threaten potential competition, even where future entry or commercialization is uncertain. But where courts are asked to adjudicate those claims, the inherited probability-centric framework still exerts substantial influence. *Meta/Within* shows that a court can accept the legal viability of potential competition theories and still resolve the case entirely on whether entry was sufficiently likely, without separately evaluating the magnitude of the lost competitive effects. *Visa/Plaid* and *Sanofi/Maze* suggest that agencies themselves are often acting on a broader intuition more consistent with expected value, while *Edwards/JenaValve* extends that intuition into innovation competition between pipeline products. Taken together, these cases suggest that the tension identified in *Steris* is not a historical curiosity, but an ongoing feature of modern merger enforcement.

V. The expected value standard: an economic approach to mergers involving potential competition

The Steris court decided the matter on the relatively narrow question of "whether, absent the acquisition, the evidence shows that Synergy probably would have entered the U.S. contract sterilization market by building one or more x-ray facilities within a reasonable period of time."[177] At trial, the judge stated that if he found this to be the case, he would find for the FTC, and, if not, he would find for the merging parties.[178] As I understand the decision, the court effectively applied a binary test: was Synergy "probably" going to enter absent the merger or not. As discussed in Section IV.A, that probability-centric test is consistent with one plausible reading of existing potential competition doctrine,[179] but is not clearly compelled by that doctrine and is economically incomplete. As I will explain, an approach that focuses primarily on whether entry crosses some threshold level of likelihood can both underenforce mergers that eliminate uncertain but consequential entry and overenforce mergers that eliminate likely entry of modest competitive import.

A. What is the expected value standard?

The idea behind the expected value standard is simple: courts and enforcers should evaluate mergers on the basis of the merger's expected effect on consumer welfare. Merger analysis is almost always probabilistic, requiring judgment calls about the likely paths of prices, innovation, product quality, and other dimensions relevant to consumer welfare both with and without the merger.[180] When mergers

[177] Decision, at 7.
[178] Transcript, 791:11-16.
[179] See the discussion of past potential competition cases in Section IV.A, e.g., United States v. Marine Bancorporation, Inc., 418 U.S. 602, 633–39 (1974) (rejecting the government's actual potential competition theory after concluding that the alleged alternative entry methods did not offer a substantial likelihood of producing deconcentration or other significant procompetitive effects); United States v. Penn-Olin Chem. Co., 378 U.S. 158, 173–76 (1964) (requiring consideration of the probability that one or both parents would have entered independently absent the joint venture), Legal scholars have likewise emphasized the probability-oriented structure and evidentiary difficulty of potential competition doctrine; see Herbert Hovenkamp, "Potential Competition," Antitrust Law Journal, 2024.
[180] An exception is the analysis of consummated mergers, which may be scrutinized or challenged by enforcers on the basis of post-merger evidence, either because the merger fell short of notification thresholds (e.g., the FTC's challenges to Polypore/Microporous, Axon/Vievu, or Otto Bock/FIH) or because subsequent events prompted

involve current competitors, courts and enforcers assess the likelihood and magnitude of harm—such as higher prices—against the likelihood and magnitude of efficiencies that may benefit consumers. Mergers involving potential competitors add another layer of uncertainty: whether entry would occur with or without the merger. Under the expected value standard, the probability of entry is considered together with the competitive consequences of entry if it occurs; in contrast, the Steris court appears to have based its decision on the probability of entry alone.

To add precision, first consider mergers involving *current competitors*. To a first approximation, courts and enforcers scrutinize mergers in proportion to a merger's net effect on consumer welfare, or expected consumer harm resulting from any lost competition between merging parties, net of expected consumer benefits resulting from any efficiencies. For convenience, refer to the net effect of a merger on consumer welfare as the expected value of a merger. In mathematical language, the expected value of a merger can be written as:

$$Expected\ value\ of\ merger = E(Harms) + E(Benefits)$$

where consumer harm (the variable $Harm$s) has a negative value, reflecting price increases, quality decreases, or other adverse effects that may result from a merger, and consumer benefits (the variable $Benefit$s) has a positive value, reflecting efficiencies that are passed through to consumers in the form of lower prices, higher quality, or similar effects. The expected value operator (notated as $E()$) denotes the expected value of either consumer harm or consumer benefits,[181] reflecting the fact that harms and benefits may be uncertain at the time a merger is evaluated. Mergers with more negative expected value are more likely to be challenged by agencies and to be blocked by courts.[182]

Mergers involving *potential competitors* add uncertainty over whether entry would occur and whether the merger changes the probability of entry. The merger's expected value therefore depends not only on the expected competitive consequences of entry if it occurs, but also on the probability of entry with and without the merger:

$$Expected\ value = [P(entry|merger) - P(entry|no\ merger)] * E(value\ of\ entry) + E(Benefits)$$

where $P(entry|merger)$ is the probability of entry if the merger occurs and $P(entry|no\ merger)$ is the likelihood of entry absent the merger, and $E(value\ of\ entry)$ is the expected consumer value of entry conditional on entry occurring. In cases where entry is unlikely to occur if the merger goes forward (as both parties alleged in *Steris*), then $P(entry|merger)$ would be zero (or close to it), and the net effect of

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enforcers to reconsider the merger (e.g., the FTC's 2020 Section 2 lawsuit against Meta, challenging, inter alia, Meta's 2012 acquisition of Instagram and its 2014 acquisition of WhatsApp).

[181] As a general matter, the expected value of an unknown variable is calculated by summing the possible values of that variable multiplied by the probabilities associated with those values. For instance, if, on a given winter day, there is a 50% chance of 2 inches of snow, a 25% chance of 4 inches of snow, and a 25% chance of 6 inches of snow, the expected value of snow accumulation is $50\% * 2 + 25\% * 4 + 25\% * 6 = 3.5\ inches$. Applying this general framework to the equation in the text, a merger's net effect on consumer welfare can be written as

$$Expected\ value\ of\ merger = \sum p_i * H_i + \sum q_j * B_j$$

where p_i is the probability that consumer harm takes on value H_i and q_i is the probability that consumer benefits take on value B_i. While courts and enforcers rarely (if ever) have sufficient information to precisely calculate such an equation, the general framework applies even if there is uncertainty over what values of harm and benefits are possible, and even if it is not possible to quantify the probabilities associated with different outcomes.

[182] See Section V.C.2 for a discussion of materiality thresholds under the expected value standard.

the merger would simplify to $-P(entry|no\ merger) * E(Harm) + E(Benefit)$.[183] But the more general expression is useful because some mergers may make entry only somewhat less likely, or may make entry *more* likely (e.g., a well-resourced incumbent purchasing a young firm lacking the resources to bring its product to market).[184] The expression for expected value given above can account for each of these possibilities.

The equations above describe a *framework* for merger evaluation, not a *methodology*. Courts and enforcers will rarely be able to quantify merger effects with mathematical precision, and the expected value standard does not depend on their doing so. The point is instead that merger analysis generally requires judgments about the plausible range of outcomes, the consumer welfare consequences of those outcomes, and the relative likelihood that those outcomes will occur. In my experience, courts and enforcers form judgments as to magnitude and likelihood of consumer harms and benefits, in a manner consistent with the equations above.

The value of describing the expected value standard in this way is that it highlights the continuity between mergers involving current competitors and those involving potential competitors. Potential competition mergers involve an additional element of uncertainty—the likelihood that entry will occur with or without the merger—but, at least from the perspective of evaluating the merger's expected harm, this is a difference in degree, not in kind, from mergers involving current competitors. The core question underlying merger analysis remains whether the merger is likely to reduce consumer welfare, accounting for both expected harms and benefits of the merger.

B. Illustrating the expected value standard

The idea behind the expected value standard is illustrated by three stylized hypotheticals.

Hypothetical # 1. A monopolist protected by durable barriers to entry (say, the need for scale, regulatory requirements, or patents) charges significant markups. There is some chance a firm in an adjacent market will be able to overcome these barriers and enter (say, a foreign competitor who has gained scale abroad and is thinking of entering the U.S., or a rival with new IP that, if it can be commercially implemented, might allow the rival to lap the incumbent). Conditional on entry occurring, there is significant evidence that prices would decrease substantially. Suppose that successful entry would result in a 25% reduction in price and, through lower prices and greater quality, $4 billion in benefits to U.S. consumers. There is a 25% chance that entry will be successful, and a 75% chance of no entry. The incumbent proposes to acquire the rival, which would lower the probability of entry to 0. If the merger occurs, it would generate distribution efficiencies that would result in $100M in consumer benefits (independent of the rival's entry). In this hypothetical, the merger prevents entry that would have occurred with 25% probability, and

[183] There are common scenarios in which a merger could plausibly make entry more likely, such as a well-resourced incumbent purchasing a new firm that may lack the resources to bring its product to market.

[184] For a concrete example, when Pfizer and Novo Nordisk were competing to purchase Metsera, a developer of a new GLP-1 drug, Pfizer stated that it and Novo Nordisk were "well-resourced [] with multibillion dollar R&D budgets that are well positioned to provide the capital and infrastructure Metsera needs to effectively navigate Phase 3 clinical trials and commercialize approved products." Pfizer went on to allege that Novo Nordisk did not have the incentive to bring Metsera's drug to market, but that Pfizer did. In the language of this section, Pfizer was alleging that $P(entry|merger\ with\ Pfizer)$ was high while $P(entry|merger\ with\ Novo)$ was low. See Complaint, Pfizer Inc. v. Novo Nordisk A/S (D. Del. Nov. 3, 2025).

which (had entry occurred) would have generated $4B in consumer benefits, with $100M in offsetting efficiency benefits. In expectation, the merger therefore causes $900M in net harms.[185]

Hypothetical #2. An incumbent producer of a differentiated good proposes to acquire a rival who has well-advanced plans to enter (say, an incumbent pharmaceutical manufacturer wishes to acquire a drug from another manufacturer that could compete with the incumbent's drug for some patients, and which has successfully demonstrated its safety and efficacy in trials). Entry is reasonably likely if the rival remains independent, but may not occur if the rival is acquired (say the incumbent's documents indicate plans to de-emphasize efforts to bring the rival's drug to market). There is a 65% chance of successful entry if the rival is independent, a 45% chance if the incumbent purchases the rival. Successful entry would result in a 20% price decrease and $3 billion in consumer benefits.[186] The merger is unlikely to generate efficiencies that would benefit consumers. The merger has an expected value of $-\$600M$, which equals the change in probability of entry caused by the merger, multiplied by the consumer benefits that would result from entry, minus the (assumed to be zero) efficiency benefits.[187]

Hypothetical #3. An entrant is planning to enter an oligopoly market but will only do so if it prevails in patent litigation; the entrant will win the litigation and enter with 51% probability, and lose and not enter with 49% probability. An incumbent proposes to purchase the entrant and makes it clear that it intends to discontinue the patent litigation and to no longer pursue entry, which would lower the probability of entry from 51% to 0%. If entry occurs, prices would fall by 3%, resulting in $10 million in consumer benefits. Regardless of whether entry occurs, the merger is expected to generate efficiencies that would result in $3M in consumer benefits. In expectation, the merger results in consumer harms of $2.1M.[188]

Table 4 summarizes the hypotheticals, and computes the *expected value* associated with each merger, computed as the change in the probability of entry produced by the merger multiplied by the consumer benefits that would be created should entry occur, net of efficiencies.

Table 4: The expected value of three hypothetical mergers

	Probability of entry		Consumer benefits	Consumer benefits	Expected value
Hypothetical	With merger	Absent merger	from entry ($M)	from efficiencies ($M)	of merger ($M)
#1	0%	25%	$4,000	$100	-$900
#2	45%	65%	$3,000	$0	-$600
#3	0%	51%	$10	$3	-$2.1

Which of these hypotheticals presents the strongest case for challenge? Under a framework focused solely or primarily on the probability of entry, Hypothetical #3 appears strongest, because it is the only one in which entry is more likely than not and the merger completely eliminates the chance of entry. By contrast, the merger reduces the probability of entry by only 25 percentage points in Hypothetical #1 and by 20 percentage points in Hypothetical #2.

Yet Hypothetical #3 is also the least harmful of the three. Blocking that merger would produce the smallest expected reduction in price and the smallest gain in consumer welfare. This perverse result illustrates the core problem with an approach centered on the probability of entry. An enforcement regime

[185] Applying the formula above, $P(entry|no\ merger) = 25\%$, $P(entry|merger) = 0\%$, $E(Value\ of\ entry) = \$4B$, and $E(Benefits) = \$100$, so the merger's expected value is $-\$900M = (0\% - 25\%) * \$4B + \$100M$.

[186] Suppose for tractability that these benefits are the same regardless of who owns the entrant.

[187] Applying the equation above, the merger's expected value is $-\$600M = (45\% - 65\%) * \$3B + \$0$.

[188] Applying the equation above, the merger's expected value is $-\$2.1M = (0\% - 51\%) * \$10M + \$3M$.

that assigns greater weight to entry probability than to the competitive effects of entry, as the *Steris* court appeared to do,[189] is likely to overenforce mergers in which entry is likely but the lost competitive benefit is modest, such as Hypothetical #3. It is also likely to underenforce mergers in which entry is less certain but the lost competitive benefit is large, such as Hypotheticals #1 and #2 above.

While I have interpreted the legal standard as requiring that entry be "more likely than not" without the merger (relative to what happens with the merger), the logic of the expected value standard and of the hypotheticals remains valid under different legal standards. For instance, if, as a legal matter, mergers involving potential competition can be blocked only if there is at least a 30% chance of entry absent the merger, the logic of the hypotheticals holds without change. At bottom, Hypothetical #3 has the greatest effect on the probability of entry and is therefore the most likely to be challenged under a standard that prioritizes entry probability, even though it has the smallest expected anticompetitive effect from forestalling entry.

As mentioned above, an expected value approach is consistent with existing practice for mergers of current (not potential) competitors. When assessing such mergers, enforcers commonly look to metrics like upward pricing pressure,[190] compensating marginal cost reduction,[191] Delta HHI,[192] and merger simulation.[193] When coupled with assessments of the volume of commerce likely to be affected by any loss in competition, such metrics allow for a prediction of the estimated consumer harm resulting from a merger.[194] There is robust theoretical and empirical support for more extreme values of these metrics indicating that more significant anticompetitive effects are likely to occur.[195] In my experience, merger enforcement often tracks estimates of consumer harm, rather than depend on a binary probability threshold. As the examples presented in Table 4 above indicate, enforcement of mergers of potential

[189] Transcript, 791:10-16 (in which the court stated "So that's the question I have to decide. What is the evidence? Does it show a probability that Synergy would have entered the U.S. market by building one or more x-ray sterilization facilities within a reasonable period but-for the merger? If so, then I grant the injunction. If not, then I don't.")

[190] Upward pricing pressure, or UPP, is a measure of the change in pricing incentive caused by the merger, reflecting each merging firm's internalization of the effect of a price change on the profits of its formerly-separate merging partner. UPP first appeared in the 2010 Horizontal Merger Guidelines and has been used by the FTC and DOJ to predict likely merger effects. See, e.g., Joshua D. Wright, Comm'r, Fed. Trade Comm'n, Statement of Commissioner Joshua D. Wright, In re Dollar Tree, Inc. & Family Dollar Stores, Inc. (July 13, 2015), https://www.ftc.gov/system/files/documents/public_statements/681781/150713dollartree-jdwstmt.pdf (describing upward pricing pressure analysis relied upon by FTC staff in identifying needed divestitures).

[191] Compensating marginal cost reduction, or CMCR, measures the reduction in costs that would be needed to offset each merging firm's unilateral incentive to increase price. CMCR is closely related to UPP and has also been used by the FTC and DOJ in assessing likely merger harms. See, for instance, *Opinion and Order*, Fed. Trade Comm'n v. Kroger Co., No. 3:24-cv-00347-AN (D. Or. Dec. 10, 2024), at 35-36 (describing the FTC expert economist's CMCR analysis); available at: https://www.doj.state.or.us/wp-content/uploads/2024/12/10T125935.982.pdf.

[192] Delta HHI refers to the change in the Herfindahl index that results from the merger and is equal to the square of the sum of the merging firms' pre-merger market shares minus the square of each firm's pre-merger market share. Delta HHI first appeared in the 1982 Merger Guidelines and has appeared in many if not most of the FTC and DOJ merger challenges since then.

[193] Merger simulation refers to inferring the parameters of a specified demand system based on observable information on margins and shares and then using economic theory to compute the implied post-merger prices. For an example of a widely-deployed merger simulation model, see Gloria Sheu & Charles Taragin, *Simulating Mergers in a Vertical Supply Chain with Bargaining*, 52 RAND J. Econ. 596 (2021).

[194] For instance, an agency may reason that a merger expected to increase price by 5% over $1 billion in commerce would result in $50 million in consumer harms.

[195] See, e.g., Volker Nocke & Michael D. Whinston, Concentration Thresholds for Horizontal Mergers, 112 Am. Econ. Rev. 1915 (2022).

competitors should follow an analogous framework, with enforcement based on the merger's expected value, rather than the probability of entry alone.

The remainder of this section discusses several issues related to the implementation and interpretation of the expected value standard.

C. Implementation and implications of the expected value standard

This section addresses four issues raised by the expected value standard: how courts and enforcers could apply it without assigning precise probabilities; how materiality thresholds would operate; how the standard relates to the 2023 Merger Guidelines; and how expected value reasoning appears in antitrust analysis outside of mergers.

1. Implementation

As a practical matter, implementing an expected value standard in potential competition matters requires the same types of information courts and enforcers already consider when evaluating mergers of current competitors. Both types of mergers typically involve an assessment of the competitive effects of lost rivalry and of any consumer benefits from efficiencies. For mergers of current competitors, an assessment of competitive effects asks whether the merger would increase price, reduce quality, diminish innovation, or otherwise harm consumers. For mergers involving potential competitors, the analogous inquiry asks how entry would affect prices, quality, innovation, or any other dimension valued by consumers. The difference is that potential competition mergers additionally require assessment of the probability that entry would occur both with and without the merger.

Evidence relevant to the assessment of the likelihood of entry with and without the merger includes contemporaneous ordinary course documents and data (e.g., describing resources devoted to entry, concreteness of entry plans, market development and customer receptivity to entry, entry costs, and regulatory barriers) and trial testimony from market participants about the viability of entry. The *Steris* court relied heavily on these types of evidence, including Synergy's contemporaneous financial model of x-ray's profitability, testimony interpreting that model, and testimony about limited support for x-ray from Synergy's senior leadership.[196]

Such evidence may be quantitative, such as a financial model, or qualitative, such as business documents on the viability of entry. Courts and enforcers already form views about the likelihood of anticompetitive and procompetitive effects based on such information when evaluating mergers of current competitors. Evaluating potential competition based on an expected value standard requires additionally leveraging such evidence to evaluate the likelihood of entry, in order to assess the merger's expected value.

As discussed above, the expected value standard does not require courts or enforcers to assign precise probabilities to different states of the world or to calculate expected values with mathematical precision. The point is instead that antitrust analysis already requires decisionmakers to evaluate uncertain evidence, form judgments about the likely range of competitive outcomes, and assess the consumer welfare consequences of those outcomes. That is true for mergers involving current competitors and potential competitors alike. The difference in potential competition cases is that decisionmakers must also assess the likelihood and timing of entry, in addition to the competitive consequences of forestalling that entry.

[196] Decision, at 27-40.

Finally, the assessment of a potential competition merger may hinge on the expected timing of entry, as well as its likelihood.[197] Entry expected farther into the future will have a lower present value of associated competitive benefits as compared to imminent entry, both because future consumer benefits should be discounted and because more distant entry may be subject to greater uncertainty. But delay should reduce the weight given to foregone entry, not remove it from the analysis. Courts and enforcers already account for timing when assessing the extent to which entry may offset competitive harms from mergers of competitors;[198] The same logic applies when the alleged harm is the loss or delay of potential entry.

2. The expected value standard under different legal approaches

As sections V.A and V.B show, the expected value standard differs from a probability-centric standard by jointly considering both the probability of entry and the consumer value that would be lost if the merger forestalls that entry. This raises a natural question about materiality. Returning to the hypotheticals presented in Table 4, hypothetical #3 is the *least harmful* of the three mergers, but it still has, by design, a negative expected value. Should that merger be blocked? Should any merger with a negative expected value be blocked? If not, what materiality threshold should apply?

Such questions are not unique to potential competition or to the expected value standard. Mergers of current competitors can also harm competition in ways that are too small, too uncertain, or too costly to warrant enforcement. Agencies address this problem partly through prosecutorial discretion, focusing limited enforcement resources on matters where intervention is likely to produce the greatest consumer welfare gains.[199] They also rely on screens and presumptions that serve, in part, a materiality function, such as the HHI and Delta HHI thresholds in the Merger Guidelines,[200] the Philadelphia National Bank market share threshold,[201] and possible use of competitive effects thresholds.[202] Courts likewise rely on such screens to at least some extent, both through precedent and through consideration of agency guidelines.

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[197] In *Steris*, Synergy business documents described opening at least two x-ray facilities by 2016, or in the relatively near future from the vantage point of the August 2015 trial. However, in other matters, entry may take considerably longer. For instance, in Pfizer's 2025 antitrust complaint against Novo Nordisk, Pfizer alleged that if Novo Nordisk purchased Metsera, the maker of a new GLP-1 drug, Novo Nordisk would have the incentive to delay entry of the drug. Following Pfizer's successful purchase of Metsera, it stated that it expected to launch Metsera's GLP-1 in 2028, or approximately 3 years post-merger. See Pfizer Inc., Edited Transcript, Pfizer Inc. at JPMorgan Healthcare Conference 7 (Jan. 12, 2026), https://s206.q4cdn.com/795948973/files/doc_events/2026/Jan/12/PFE-USQ_Transcript_2026-01-12.pdf.

[198] See, inter alia, FTC v. Wilhelmsen Drew, in which the merging parties alleged that entry was easy and would happen quickly if prices rose, while the court found that the existence of barriers to entry made entry difficult, despite high pre-merger margins. *FTC v. Wilh. Wilhelmsen Holding ASA*, No. 1:18-cv-00414 (TSC), slip op. at 49-54 (D.D.C. July 13, 2018).

[199] See, for instance, Dissenting Statement of Commissioner Andrew N. Ferguson In the Matter of Southern Glazer's Wine and Spirits, LLC, stating his view that enforcement of the Robinson-Patman Act against Southern Glazer's "would be an imprudent use of the Commission's enforcement resources even if it were likely to prevail."

[200] U.S. Dep't of Justice & Fed. Trade Comm'n, Merger Guidelines 5–6 (2023) (hereinafter 2023 Merger Guidelines), available at https://www.ftc.gov/system/files/ftc_gov/pdf/2023_merger_guidelines_final_12.18.2023.pdf.

[201] *United States v. Philadelphia Nat'l Bank*, 374 U.S. 321, 363–65 (1963) ("The merger of appellees will result in a single bank's controlling at least 30% of the commercial banking business in the four-county Philadelphia metropolitan area. Without attempting to specify the smallest market share which would still be considered to threaten undue concentration, we are clear that 30% presents that threat.").

[202] See Carl Shapiro, "Updates from the Antitrust Division," at 24 ("Current Division practice is to treat the value of diverted sales as proportionately small if it is no more than 5% of the lost revenues.")

These same screens and metrics could be adapted when evaluating potential competition mergers. Section 7's use of "may" is consistent with a probabilistic, predictive inquiry into future competitive effects, but it does not imply that any speculative possibility of harm suffices for enforcement. Some materiality threshold remains necessary. In applying such a threshold, a lower probability of entry absent the merger would generally require a stronger showing of competitive significance, whether through market concentration, the magnitude of the likely competitive effects, or other evidence that the foregone entry would have mattered to consumers. Conversely, a smaller expected effect may be sufficient where entry is more likely. Over time, explicit thresholds could develop—for example, requiring a given probability of foregone entry together with a specified level of concentration or expected competitive effect. More likely, such thresholds would remain implicit and evolve through agency practice and precedent.[203] The point is not that Section 7 allows enforcement based on any remote possibility of harm. Rather, it is that the statute calls for a probabilistic and predictive inquiry, not a rigid requirement that the government prove the foregone entry would more likely than not have materialized in precisely the form alleged.

Finally, a related problem with applying a probability threshold to evaluate potential competition mergers is that such an approach may allow an incumbent to acquire multiple potential entrants sequentially, even if the collective expected competitive harm is substantial. If each entrant is evaluated in isolation, each acquisition may appear to involve too low a probability of successful entry to warrant enforcement. But the acquisitions may collectively eliminate a substantial probability that at least one entrant would have succeeded.[204] A probability centric approach that evaluates each transaction in isolation could therefore permit the incumbent to acquire all of the potential entrants, even though the combined effect of those acquisitions would be to eliminate a meaningful competitive threat.

3. Treatment of potential competition in 2023 Merger Guidelines

The 2023 Merger Guidelines gesture toward an expected value standard for the evaluation of potential competition mergers, stating that "the higher the market concentration, the lower the probability of entry that gives rise to concern."[205] This language recognizes that the probability of entry needed to raise competitive concern should vary with the expected significance of that entry. But the Guidelines operationalize that significance primarily through the concentration of the affected market, rather than the *effect* of entry, and thus may not fully focus analysis on the expected value of a merger implicating potential competition. In this sense, while the Guidelines can be read as indirectly accounting for the magnitude of competitive harm by treating concentration as a proxy for the significance of entry, they stop short of directly evaluating the expected competitive effects associated with the entry foregone by the merger. An expected value standard would ask more directly how much consumers would benefit from the foregone entry—through lower prices, higher quality, increased innovation, or other channels valued by consumers—while also assessing the degree to which the merger reduces the likelihood of entry.

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[203] For instance, the concentration thresholds in the 2023 Merger Guidelines and previous iterations of the Guidelines appear not to closely predict which mergers will and will not be enforced. See Carl Shapiro & Howard A. Shelanski, *Judicial Response to the 2010 Horizontal Merger Guidelines*, 58 Rev. Indus. Org. 51 (2021) (at 64, finding that from 2000-2020 enforced mergers had HHIs and Delta HHIs far in excess of thresholds listed in Guidelines).

[204] For empirical results on serial acquisitions, see Thomas G. Wollmann, *How to Get Away with Merger: Stealth Consolidation and Its Real Effects on US Dialysis* (May 2026) (unpublished manuscript) (forthcoming in *J. Pol. Econ.*).

[205] 2023 Merger Guidelines, at 10.

The Guidelines also retain a distinct probability screen by requiring a "reasonable" probability of entry. The Guidelines do not define this term, and the requirement could be read as treating the probability of entry as a separate prerequisite rather than as one input into an assessment of the expected value of a merger, i.e., the probability of entry must be "reasonable," regardless of the competitive benefits that would result from that entry. This framing can matter for how mergers involving potential competition are approached. For instance, if a "reasonable" probability requires a probability of entry above (say) 50%, the Guidelines would not flag Hypothetical #1 in Table 4 as raising concern, even though that merger has the largest negative expected value of the three hypotheticals. Conversely, Hypothetical #3 would satisfy such a probability screen even though it is the least consequential merger in expected value terms. Concentration is therefore a useful proxy for the likely significance of foregone entry, but it should not be dispositive: the relevant question is whether the entry would likely have produced material consumer benefits, whether through lower prices, higher quality, increased output, innovation, greater bargaining leverage, or other dimensions of competition.

4. Applying the expected value approach to non-merger matters

While the above discussion focuses on *mergers* involving potential competitors, the logic of the expected value standard appears throughout antitrust. Rule of reason and monopolization cases often require courts to evaluate uncertain future harms, weigh them against claimed benefits or justifications, and decide whether intervention is warranted before all competitive effects have been realized. Such matters may turn not only on the immediate effect of some conduct—such as predation, bundling, tying, or exclusive dealing—but also on whether the conduct impairs a rival's ability to enter or expand and on how competitively significant that entry or expansion would be if it emerged. For this reason, courts commonly evaluate both the likelihood of entry with and without the conduct and the competitive consequences of that entry, rather than focusing solely on the former.

The DOJ's litigation against Microsoft provides a useful example. The government's theory depended not merely on the possibility that middleware would evolve into a competing platform, but also on the substantial competitive significance such a development would have had for Microsoft's operating system monopoly.[206] Although the D.C. Circuit did not frame its analysis in expected value terms, the case can be understood as depending on both propositions: that middleware represented a genuine potential threat to the applications barrier to entry, and that erosion of that barrier would substantially constrain Microsoft's monopoly power.[207] The same conceptual structure underlies the expected value approach to potential competition mergers: the analysis should consider both the likelihood that future competition will emerge and the competitive consequences if it does.

VI. Applying the expected value standard to Steris/Synergy

The *Steris* court stated that it would have granted the FTC's request only if it found "Synergy probably would have entered the U.S. contract sterilization market by building one or more x-ray facilities within a

[206] See United States v. Microsoft Corp., 253 F.3d 34, 53–56 (D.C. Cir. 2001) (en banc) (per curiam) (explaining that Netscape Navigator and Java threatened to erode the applications barrier to entry protecting Microsoft's operating-system monopoly by providing a platform on which applications could run independently of Windows); id. at 79 (concluding that Microsoft's conduct helped preserve its monopoly by protecting that barrier to entry).

[207] The court did not expressly separate the likelihood that middleware would mature into a platform-level competitive threat from the competitive consequences of such a development. Nevertheless, its analysis depended on both propositions: that middleware represented a genuine potential threat to the applications barrier to entry and that erosion of that barrier would substantially constrain Microsoft's monopoly power. See id. at 53–56, 79.

reasonable period of time."[208] The court's decision thus effectively followed a probability-centric approach, in that once the court concluded that Synergy's entry was insufficiently likely, it had little reason under its framework to separately assess the competitive significance of the entry that the merger allegedly eliminated.

It is impossible to confidently determine whether the outcome would have differed had the court instead applied an expected value approach. The evidence presented in Sections II and III indicates that Synergy's entry had some meaningful probability of occurring and that, if it occurred, it likely would have resulted in nontrivial competitive benefits. At the same time, the deliberate pace of Steris's own x-ray expansion suggest caution in concluding that an independent Synergy would have achieved its ambitious goal of opening multiple U.S. x-ray facilities in 2016. A later launch would have reduced the merger's expected competitive harm as viewed from the time of trial. Even so, as I will explain, for the reasons explained below, the balance of the evidence indicates that the transaction created material expected harm.

As described above, applying an expected value standard to *Steris* requires assessing both the probability of Synergy's entry and the competitive effects of that entry if it occurred. The *Steris* court did not opine on the probability of entry by an independent Synergy beyond finding that it was below the court's "probably" threshold.[209] If that threshold is understood to require a likelihood of entry greater than 50%, then the court's conclusion follows under a probability-centric approach.

Under an expected value approach, however, that analysis is incomplete. A finding that entry was less likely than "probable" does not by itself resolve the merger's expected competitive effect. To make such an assessment, the court would have needed to ask two additional questions. First, how likely was independent entry—not simply whether the probability crossed a threshold, but whether it was close to that threshold or close to zero. Second, how competitively significant would that entry have been if it occurred? The *Steris* court did not address these questions because, under its probability-centric framework, a finding that independent entry fell below the "probably" threshold was sufficient to resolve the case in favor of the merging parties.

Would the outcome in *Steris* have differed had the court applied an expected value standard? This is, of course, impossible to say with confidence. However, the evidence described above does support three inferences relevant to that assessment. First, when Steris and Synergy agreed to merge, Synergy had devoted substantial resources to a U.S. x-ray expansion, and the contemporaneous evidence produced at trial strongly suggests that Synergy was seriously pursuing that expansion. Second, the evidence strongly points to Synergy x-ray having the potential to take business from Steris gamma, and to drive down prices to the benefit of consumers. Third, while Synergy had planned for x-ray entry in 2016, there is some reason to doubt that it could have achieved this timetable, and any delay in entry would have reduced the expected competitive harm from the merger as assessed at the time of trial, even if the entry itself remained competitively significant.

Likelihood of entry. Section II and Appendix I describe contemporaneous evidence that Synergy had advanced plans for a U.S. x-ray expansion at the time it agreed to be acquired by Steris. They also show that Synergy continued to pursue those plans after the merger announcement, except for aspects like site selection that would depend on whether Steris was a competitor or an owner. There is no need to recount that evidence here. For present purposes, the important point is that the record supports there being a meaningful probability that Synergy would have continued pursuing U.S. x-ray entry as an independent

[208] Decision, at 7.
[209] *Id.*

firm, whether or not that probability exceeded the *Steris* court's "probably" threshold. That conclusion is supported by three categories of evidence: Synergy's continued investment in and planning for x-ray around the time of the merger announcement; the reconstruction of Synergy's financial model, which does not support the especially negative characterization of x-ray's prospects offered at trial; and Steris's later x-ray deployment, which provides retrospective evidence that x-ray was commercially viable and could attract customer demand. Although each category of evidence is subject to interpretation, two aspects of the district court's analysis are difficult to reconcile with the record.

First, the court placed too much weight on the timing of Synergy's decision to terminate its x-ray expansion. The court treated the February 2015 termination—six days after meeting with FTC staff and learning that staff viewed the merger as potentially eliminating Synergy's planned x-ray entry—as "the best evidence that [Synergy terminated its x-ray program] for legitimate business reasons, as opposed to anti-competitive ones."[210] In the court's view, "the last thing Synergy would have done, if the Steris merger was driving its U.S. x-ray strategy, would have been to pull the plug immediately after meeting with the FTC staff [] as Synergy had to know that doing so would only have solidified the FTC's position."[211]

The court's inference is difficult to square with the broader factual record. As discussed in Section II.C, Synergy continued to take steps toward U.S. x-ray expansion after the merger announcement, including publicly announcing the expansion to investors and continuing work on customer outreach, site evaluation, and supplier discussions. At the same time, the pending merger appears to have affected aspects of Synergy's planning that would naturally depend on whether Steris remained a competitor or became Synergy's owner, including market development and final site selection. The February 2015 termination is therefore at least as consistent with the FTC's theory as with the court's. Synergy continued to move forward while the parties expected the transaction to close, slowed or reconsidered elements of the plan in light of the pending merger, and terminated the project only after FTC staff identified the loss of Synergy's planned entry as an antitrust concern. The contemporaneous email explaining that "[t]his whole FTC inquiry is going down a rat hole"[212] before stating that Synergy could not proceed with x-ray in the Americas reinforces that interpretation: the termination followed directly from the FTC inquiry's focus on x-ray, not from some newly discovered commercial defect in the project. On that record, Synergy's continued post-announcement work on x-ray should increase, not decrease, the inference that an independent Synergy would have continued pursuing U.S. x-ray entry.

Second, the court placed substantial weight on Synergy's financial projections without the benefit of expert testimony interpreting those projections. As discussed in Section III.C and Appendix II, the projected return from Synergy's U.S. x-ray expansion depended on technical modeling choices, including the treatment of long-lived assets, the relevant time horizon, assumed capital costs, expected utilization, and the relationship between x-ray and gamma pricing. Those issues are not self-interpreting. Yet the court declined to hear live economic testimony, stating in an order that direct testimony of experts would be presented solely through expert reports.[213] Neither party chose to cross the other party's expert witnesses, and, consequently, there was no expert trial testimony of any kind.[214] The court's opinion did

[210] Decision, at 39-40.
[211] Id.
[212] McLean (Synergy) Transcript, 358:22-359:5.
[213] *Case Management Plan and Scheduling Order*, Fed. Trade Comm'n v. Steris Corp., No. 1:15-cv-01080-DAP (N.D. Ohio June 8, 2015) (ECF No. 24).
[214] A review of the entire transcript, which does not have any redactions, indicates that no expert witness were called.

not cite any expert testimony.[215] The result is that the court assigned significant weight to fact-witness characterizations of a financial model whose economic implications required interpretation.

The court's opinion nonetheless relied heavily on detailed claims about Synergy's financial model that were presented through a fact witness, Synergy's CFO Gavin Hill. Although FTC staff cross-examined Hill, the record did not include live expert testimony interpreting either the model or Hill's characterizations of it. My own replication of the model—necessarily limited because it was done without access to nonpublic documents, including the model itself—casts doubt on the relevance and reliability of some of Hill's testimony. In particular, the replication indicates that, whatever the broader merits of moving forward with x-ray, Synergy's own model placed the project at or near Synergy's asserted 15% IRR threshold, even while incorporating conservative assumptions that, if relaxed, meaningfully increased the project's return.

An expert witness, with the benefit of full access to nonpublic documents and the model itself, could have provided important context for Synergy's fact witness testimony. That context would have been especially useful because the court's Decision reached conclusions about the model that depended on interpreting financial and economic concepts such as internal rate of return, investment horizon, asset life, terminal value, and the treatment of conservative modeling assumptions. In the absence of such testimony, the court relied heavily on fact-witness characterizations of what the model showed. For the reasons discussed in Section III.C and Appendix II, I believe that reliance led the court to place too much weight on the model as evidence that Synergy's x-ray expansion was financially nonviable.

In sum, the trial record does not attempt to definitively pin down the probability that an independent Synergy would have entered, as it had no need to do so when applying a probability-centric approach. As I have described, the weight of the evidence indicates that Synergy's entry was at least somewhat likely. Under an expected value approach, this evidence is sufficient to require the next step in the analysis, i.e., assessing the competitive significance of Synergy's prospective entry if it occurred. Even allowing for different interpretations of the record, Synergy's entry was not so remote or speculative that its competitive consequences could be ignored. As the hypotheticals presented in Table 4 demonstrate, entry need not be more likely than not for a merger to create material expected harm if the foregone entry was likely to be competitively significant.

The more relevant question is therefore not simply whether entry crossed the court's "probably" threshold, but whether the merger eliminated a meaningful chance of competitively significant entry.

Timing of entry. The evidence is more mixed as to the likely timing of Synergy's entry. Synergy documents contemplated opening at least two U.S. x-ray facilities by 2016, but at the time of the 2014 merger announcement Synergy's plans had not advanced to the point where one could be confident of that timeline. Synergy had not yet acquired sites, broken ground, or even finalized the specifications of the x-ray accelerators it would purchase. While these are not insurmountable obstacles, they provide reason for caution in assuming that Synergy would have entered as quickly as its documents projected.

Steris's own experience with x-ray reinforces that caution, although it is not a perfect proxy for Synergy's x-ray efforts. Steris appears to have encountered delays in opening announced x-ray facilities, including at locations associated with existing Steris operations. Steris's Libertyville, Illinois, x-ray facility opened approximately five years after its announcement.[216] Its planned x-ray location in Northborough,

[215] A review of the court's opinion indicates that no expert witness was cited.
[216] Steris's x-ray plant in Libertyville, IL was announced in November 2019, but was not opened until June 2024, despite the x-ray facility being an expansion of an existing Steris facility.

Massachusetts was scuttled entirely due to opposition from the Northborough Planning Board.[217] Other announced facilities appear to have remained unopened for multiple years as of writing.[218] Additionally, Steris's own x-ray expansion followed its acquisition of Mevex, an accelerator supplier. It is possible that Steris's vertical integration reduced the cost of opening new x-ray facilities, relative to using externally sourced IBA accelerators, as Synergy planned to do.[219]

Steris's own delays with x-ray suggest that even a firm with Steris's existing customer base, operating network, and ability to co-locate x-ray capacity faced a meaningful implementation period. At the same time, Steris, as a gamma incumbent, lacked an entrant's motive to enter into a "street fight" with gamma,[220] and its delays may reflect its incumbency.

Indeed, Synergy's own plans contemplated a gradual ramp-up in x-ray output over several years,[221] with an initial emphasis on industrial and e-beam customers rather than the medical-device business most closely associated with gamma sterilization.[222] Thus, Synergy's entry may not have imposed its fullest competitive constraint on Steris, which disproportionately sterilizes high-value medical devices,[223] for some time.

At the same time, delay is not the same as non-entry. Under an expected-value approach, a later launch would reduce the present value of the competitive benefits from Synergy's entry and would increase uncertainty about whether entry would ultimately occur. But it would not eliminate the relevance of the foregone entry. The appropriate inference is therefore not that Synergy's planned entry should be disregarded because its timing was uncertain, but that any expected competitive harm should be discounted to reflect likely delay, gradual ramp-up, and execution risk.

Competitive effects of Synergy's entry. The evidence on the likely competitive significance of Synergy's entry is stronger than the evidence on the precise probability or timing of that entry. If Synergy had successfully opened U.S. x-ray facilities, the contemporaneous record indicates that those facilities would have competed directly with Steris's gamma facilities for at least some customers. Synergy documents described the U.S. x-ray expansion as targeting gamma business from Steris and Sterigenics, anticipated competitive responses from those incumbents, and treated x-ray as a way to offer customers an alternative to gamma. Customer testimony likewise identified potential advantages of x-ray, including faster processing and reduced handling. The likely competitive effects therefore included not only the possibility of lower prices, but also increased bargaining leverage for customers, improved service quality, shorter turnaround times, and additional pressure on incumbents to invest in or deploy x-ray capacity.

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[217] See note 74, *supra*.
[218] For instance, Steris first announced an x-ray location on the U.S. east coast in 2019. After its original location was scuttled due to regulatory barriers, Steris did not open an east coast x-ray location until July 2026, more than seven years after announcement.
[219] However, IBA has lost money on its accelerator segment as recently as 2023, which suggests (but does not prove) that externally sourcing an accelerator at market prices may not have been dramatically more expensive than producing one internally. See IBA Annual Report 2023, at 127 (showing an EBIT for IBA's "Proton Therapy and Other Accelerators" segment of EUR -636,000). https://www.iba-worldwide.com/sites/default/files/2024-04/iba_annual-report-2023_digital_en.pdf.
[220] See note 55 and surrounding text, *supra*.
[221] See Section III.C, *supra*.
[222] Tyranski (Synergy) Transcript, 514:1-4.
[223] McLean (Synergy) Transcript, 385:14-16.

Discussion. The Steris decision can be assessed in two related but distinct ways. The first is on the probability-centric terms applied by the district court. Even under that framework, two aspects of the court's reasoning are difficult to reconcile with the record. First, the court treated Synergy's February 2015 termination of the U.S. x-ray project—shortly after Synergy learned that FTC staff viewed the loss of x-ray entry as an antitrust concern—as strong evidence that the project was independently nonviable.[224] But Synergy's continued post-announcement work on x-ray, together with the contemporaneous "going down a rat hole" email, supports a different inference: the pending merger and ensuing FTC inquiry affected Synergy's incentives and timing. The court also relied heavily on fact-witness characterizations of Synergy's financial model without expert testimony interpreting the model's economic significance. As discussed above, a reconstruction of the model casts doubt on the conclusion that Synergy's own projections showed x-ray to be financially nonviable.

The second assessment asks how the merger looks under an expected value approach, which does not require that Synergy "probably" would have entered, much less that it certainly would have done so, but instead requires evaluating both the likelihood of independent entry and the competitive significance of that entry if it occurred. On that view, the evidence points to a meaningful probability that an independent Synergy would have continued pursuing U.S. x-ray entry, and stronger evidence that successful entry would have mattered competitively. As described in Section II.C and Appendix I, Synergy's planned x-ray facilities were expected to target gamma business from Steris and Sterigenics, give customers an additional source of bargaining leverage, and potentially discipline prices, quality, turnaround time, and incumbent investment incentives.

The principal caution concerns timing. Synergy's 2016 entry target may have been optimistic, and Steris's later x-ray rollout suggests that implementation could have taken years and proceeded gradually. That delay should reduce the expected competitive harm attributed to the merger as of the time of trial. But discounting is not dismissal. An expected value framework does not imply that the transaction mechanically should have been blocked; it implies that the court should have weighed the probability, timing, and magnitude of the lost x-ray competition rather than treating entry probability as dispositive. The best expected value assessment of Steris, then, is neither that Synergy's entry was certain and immediate nor that it was too speculative to matter. Rather, Synergy had a meaningful probability of entering, and the expected competitive value of that entry remained material even after accounting for delay, gradual ramp-up, and execution risk.

The FTC did not appeal the court's ruling and dropped its parallel administrative action against the parties. As an economist, I do not assess, as a legal matter, whether an appeal would have been viable, prudent, or likely to succeed. The narrower point is that the economic critique developed here does not depend on viewing Steris as plainly contrary to existing doctrine. Pre-Steris precedent required courts to assess whether independent entry was sufficiently likely, but the cases were not uniform in how they related likelihood of entry to the competitive significance of that entry. From that perspective, an appeal could have raised the question whether the district court gave dispositive weight to the "probably" threshold without adequately considering the magnitude of the competitive benefits that successful entry would have produced. Separately, the court's treatment of the timing of Synergy's x-ray termination as among the "best evidence" favoring the parties, and its reliance on fact-witness characterizations of Synergy's financial model without expert testimony interpreting the model's economic significance, provide economic reasons to question the decision. These points do not establish that *Steris* was legally

[224] Decision, at 39.

wrong. They do indicate why, from an economic perspective, the decision should not be treated as foreclosing an expected value approach to potential competition.

VII. Conclusion

This article has two principal contributions. The first is retrospective. The Steris court concluded that Synergy's planned U.S. x-ray expansion was insufficiently likely to support relief under Section 7. With the benefit of nearly a decade of additional evidence, that conclusion appears less secure than it did at the time of trial. Steris itself subsequently relied on x-ray for virtually all of its incremental radiation sterilization capacity, suggesting that x-ray proved commercially viable and strategically important. Steris's sterilization margins increased substantially following the merger; while that evidence is not dispositive, it is consistent with the possibility that the transaction eliminated meaningful competitive pressure. A replication of Synergy's contemporaneous financial model indicates that trial testimony characterizing the project as financially unattractive depended on assumptions that are difficult to reconcile with standard economic reasoning.

The timing of Synergy's February 2015 abandonment points in the same direction. While the district court treated the timing of Synergy's decision to terminate the x-ray project as among the strongest evidence that the project was abandoned for independent business reasons, Synergy's actions following the merger announcement are at least as consistent with the opposite inference: Synergy continued to take steps toward x-ray expansion after the merger was announced, slowed or reconsidered aspects of the project in light of the pending transaction, and terminated the U.S. x-ray program shortly after FTC staff expressed concern that the merger would eliminate Synergy's planned entry.

None of this evidence can establish with certainty that Synergy would have entered absent the merger, much less that Synergy would have replicated Steris's scale or timing. But the retrospective record provides substantial reason to doubt the view that Synergy's x-ray plans were so speculative or uneconomic as to render the loss of potential competition immaterial.

The second contribution is analytical and doctrinal. Potential competition cases are inherently probabilistic because they require courts to evaluate competition that has not yet fully emerged. Courts have often approached such cases through a probability-centric lens, asking whether entry was sufficiently likely while giving comparatively little attention to the magnitude of the competitive benefits that entry would have generated. Steris and Meta/Within illustrate this tendency. Edwards/JenaValve points in a similar direction in the innovation context, where the court treated ongoing rivalry to develop a future product as competitively meaningful despite uncertainty over ultimate commercialization. As discussed above, that framework is consistent with one plausible reading of existing doctrine, but it should not be treated as foreclosing an economic approach that gives weight to both the likelihood and significance of foregone entry. From an economic perspective, competitive harm from a merger involving potential competition depends on both the likelihood and significance of lost entry. A merger that eliminates a moderately likely but highly consequential competitive threat may be more harmful than one that eliminates highly likely entry with comparatively modest effects. Potential competition mergers are therefore better understood through an expected value framework that evaluates both dimensions together.

The expected value framework is not intended to require courts or agencies to calculate merger effects with mathematical precision. Rather, the framework identifies the dimensions that should inform the analysis: the likelihood that entry would occur absent the merger, the extent to which the merger changes that likelihood, the competitive significance of entry if it occurs, any merger-specific benefits, and the timing with which those harms and benefits would be realized. Courts and enforcers already make

analogous judgments in evaluating mergers between current competitors, using available evidence, economic tools, expert testimony, precedent, and administrable screens to assess likely competitive effects. Potential competition mergers require the same type of assessment, with the additional step of evaluating the likelihood and timing of entry. The central point is therefore not that expected harm can typically be calculated precisely, but that entry probability should be evaluated together with the competitive consequences of lost entry, rather than treated as a dispositive threshold issue.

Applied to Steris/Synergy, an expected value standard provides additional reason to question the district court's conclusion that the merger was unlikely to harm competition. The evidence does not show that Synergy's entry was certain or that its competitive effects would have been immediate. But it does suggest a material probability of entry and potentially substantial benefits from that entry, whether through lower prices, higher quality, additional innovation around x-ray sterilization, or some combination of these effects. When both likelihood and competitive significance are considered, the merger appears more problematic than it does under a binary inquiry into whether Synergy "probably" would have entered. More broadly, the case illustrates why potential competition analysis should move beyond probability thresholds and toward a fuller assessment of the expected competitive benefits that mergers may eliminate.

Steris thus remains important not simply because it was the first modern litigated potential competition merger challenge, but because it illustrates the limits of treating probability as dispositive. The retrospective evidence does not prove that Synergy's entry was certain, immediate, or independently sufficient to require relief. It does show why the loss of that entry should not be dismissed solely because it fell below a "probably" threshold. For mergers involving potential competition, the economically relevant question is whether the transaction eliminates a meaningful chance of competitively significant rivalry. That question requires attention to probability, magnitude, timing, and efficiencies together.

Appendix I: Selected additional record evidence on Synergy's planned U.S. x-ray entry

This Appendix provides additional description of the factual record of Synergy's contemplated x-ray entry, as reflected in the publicly-available trial record.

A. Evidence that Synergy viewed x-ray as strategically important

- Synergy acquires the Däniken, Switzerland x-ray facility in 2012.[225] Synergy's CEO (Richard Steeves) states that Synergy could not gain a competitive advantage over Steris and Sterigenics only by offering EO, gamma, or e-beam,[226] but noted that "we do, however, currently hold a competitive advantage over competitors with the knowledge and experience in x-ray technology" and contemplated an "x-ray expansion in the U.S. to target over $120 million in Steris and Sterigenics revenue."[227]
- **Steeves describes** a "bold plan, x-ray expansion in the U.S" in 2013, stating that x-ray could be "faster, better cheaper" than gamma.[228]
- Steeves hires Andrew McLean as U.S. CEO for sterilization, with Steeves telling McLean "I'm keen to develop the x-ray service as a potential game changer" and "this is one of the key projects I would like you to lead."[229] Steeves tells McLean "We haven't run the numbers, but intuitively, I think it could be lower cost than gamma and it would beat the gamma service on every other operating metric."[230]
- In July 2014, Steeves tells Synergy's PLC board that Sterigenics' acquisition of Cobalt-60 supplier Nordion "could create a new opportunity for Synergy given the concern around [Nordion's] dominance."[231]

B. Evidence that the plan was operationally concrete by 2014

- McLean and a deputy (Gaet Tyranski) obtain customer letters of interest, with Tyranski telling one Synergy customer, Covidien, that "Synergy is in the final stages of gaining board approval for wholesale investments in x-ray capacity in the Americas as an alternative to gamma in the U.S., at comparable pricing."[232] Synergy obtained letters of interest from at least five large customers, including Johnson & Johnson, Community Tissue, Becton Dickinson, Stryker, and Bayer.[233]
- Tyranski sought and obtained tax incentives from state and local governments in Indiana and Texas, the planned sites for Synergy's first two x-ray facilities.[234]
  McLean and his team made presentations to Synergy's Senior Executive Board (SEB, Synergy's management board) in July and September 2014. The team's September deck stated that x-ray

[225] See Synergy Health Expands X-Ray Business, *AuntMinnieEurope.com* (AuntMinnieEurope.com staff writers, Mar. 20, 2012), available at https://www.auntminnieeurope.com/industry-news/article/15644519/synergy-health-expands-x-ray-business.
[226] Steeves (Synergy) Transcript: 152:23-153:1.
[227] Steeves (Synergy) Transcript, 153:10-155:1.
[228] Steeves (Synergy) Transcript, 155:18-22.
[229] Steeves (Synergy) Transcript, 157:10-18.
[230] McLean (Synergy) Transcript, 273:4-8.
[231] Steeves (Synergy) Transcript, 159:24-160:2.
[232] Tyranski (Synergy) Transcript, 506:3-7.
[233] McLean (Synergy) Transcript, 307:23-308:6.
[234] Tyranski (Synergy) Transcript, 508:20-509:2; 542:3-544:16.

had already attracted "Significant customer engagement. Very high interest"[235] and that Synergy anticipated beginning to operate at least two x-ray facilities in 2016.[236]

C. Evidence that Synergy management was invested in x-ray

- At its September 17, 2014 meeting, the SEB approved the U.S. x-ray strategy; McLean reacted by writing "clearly this is a major achievement and marks the true beginning of what I believe will be a fundamental change to the way in which products are sterilized in the long-term future in the U.S."[237]
- McLean summarized the SEB's decision by saying "We are going to completely transform how irradiation sterilization is done in the U.S. and we have a compelling value proposition to support that, hence our board having the confidence to make a very large capital investment to underpin a new nation-wide network."[238]
- McLean cautioned his team to "please keep this confidential for now as we want to announce this to the market and our customers at a later date with maximum impact."[239]
- McLean anticipated that Synergy's soon-to-be-announced x-ray plans would be "a big disruption to the U.S. irradiation market" and told Synergy's anticipated x-ray supplier, IBA, that "we need to have a carefully orchestrated communications program and timing."[240]
- Adrian Cowherd, Synergy's COO, wrote to Tyranski following the presentation, saying "you did a very good job today with your presentation, both in terms of content and in the way you delivered it. [] So this goes to show how well you did in helping us to get to the right outcome."[241]
- Steeves wrote to Tyranski saying "your presentation was very good [] Let's fine tune the CAPEX for the expansion plans and regroup at the end of the month."[242]
- On September 18, 2014, Steeves presented the x-ray strategy to Synergy's PLC board, telling them that McLean was negotiating exclusivity with IBA, a supplier of x-ray accelerators, in exchange for Synergy's making down payments on two machines of EUR 300 thousand each,[243] but did not request "formal approval of the [] plan of four x-ray facilities costing 40 to 50 million pounds;"[244] Steeves understood that the deposits could also be used for e-beam machines if Synergy elected not to go forward with x-ray.[245]
- Synergy CFO Gavin Hill "advised that as mentioned in the July meeting, the requests for CAPEX continued to be high."[246]
- Synergy COO Adrian Cowherd stated that if the negotiations with Steris did not lead to a definitive agreement, he thought it "unlikely" that "there would be a decision to back away from

[235] McLean (Synergy) Transcript, 291:19-292:10.
[236] McLean (Synergy) Transcript, 313:2-6.
[237] McLean (Synergy) Transcript, 321:12-21.
[238] Complaint Counsel's Post-Hearing Brief, In re Steris Corp. & Synergy Health plc, FTC Docket No. 9365 (Sept. 2, 2015), at 4.
[239] McLean (Synergy) Transcript, 322:18-22.
[240] McLean (Synergy) Transcript, 324:10-25.
[241] Tyranski (Synergy) Transcript, 521:10-23.
[242] Tyranski (Synergy) Transcript, 522:17-24.
[243] Steeves (Synergy) Transcript, 162:8-21; McLean (Synergy) Transcript, 320:19-24.
[244] Baroudel (Synergy) Transcript, 470:2-21.
[245] Steeves (Synergy) Transcript, 223:1-18.
[246] Baroudel (Synergy) Transcript, 467:15-468:6.

x-ray for North American, given that it would be very difficult to provide gamma sterilization in North America."[247]

- Steeves told the PLC board that he would not be keen to install more gamma capacity in the U.S.[248] and that "with the cobalt costs likely to increase while electricity costs were falling, it was likely that x-ray would be preferred to cobalt sterilization in any event."[249]
- The week of October 7, 2014, McLean staged a three-day x-ray kickoff meeting for Synergy employees in Tampa, FL, which was attended by McLean's x-ray team and by Synergy employees from both the U.S. and Europe.[250]
- At the meeting, Tyranski and McLean presented slides stating "the U.S. x-ray strategy was approved by the SEB in September. Following this approval, Phases 1 and 2 for the strategy will be rolled out immediately. [] This will be the largest organic growth project in terms of both capital expenditure and reach ever undertaken by Synergy," with "Phase 2" referring to "complete building and start operation of at least two commercial scale x-ray facilities."[251]
- The slides stated that McLean and Tyranski had received the following "feedback" from the SEB: "further reduce CAPEX by at least $1.5 million, further validate the locations, finalize the exclusivity provisions with IBA, and go for it!"[252] The slides did not mention gating hurdles to the project beyond reducing capex.[253]

D. Evidence that work continued after the merger announcement

- Steris announced its proposed acquisition of Synergy on October 13, 2014.[254]
- On October 21, 2014, Tyranski sent an email to his team stating "we've made a difficult but sensible decision to stop any market development expense on x-ray outside the already budgeted and ongoing activity in Däniken/Europe while we wait for the Steris transition."[255]
- In the same email, Tyranski assured his team the x-ray strategy was still proceeding otherwise as planned and stated "I [] imagine we will have to re-present the business case to the new Steris board."[256]
- On November 4, 2014, Synergy publicly announced its x-ray rollout, saying "we are pleased to announce that we have signed an agreement with IBA for x-ray technology to be deployed in the United States, supplemented by our in-house knowledge and expertise."[257]
- The same disclosure stated, referring to the Däniken x-ray facility, that "our x-ray services are now the fastest growing of our […] technologies, driven by the higher levels of quality, favorable economics, and faster processing speed."[258]

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[247] Baroudel (Synergy) Transcript, 491:5-23.
[248] Steeves (Synergy) Transcript, 163:7-164:1.
[249] Baroudel (Synergy) Transcript, 492:6-18.
[250] McLean (Synergy) Transcript, 327:10-23; Tyranski (Synergy) Transcript, 525:18-20.
[251] Tyranski (Synergy) Transcript, 526:17-527:7.
[252] Tyranski (Synergy) Transcript, 527:13-17.
[253] Tyranski (Synergy) Transcript, 527:24-528:4.
[254] STERIS Corp., *STERIS to Acquire Synergy Health for $1.9 Billion in Cash and Stock* (Oct. 13, 2014), https://sterisplc.gcs-web.com/news-releases/news-release-details/steris-acquire-synergy-health-19-billion-cash-and-stock/.
[255] Tyranski (Synergy) Transcript, 532:1-6.
[256] Tyranski (Synergy) Transcript, 532:16-23.
[257] Steeves (Synergy) Transcript, 166:25-167:3.
[258] Steeves (Synergy) Transcript, 167:13-19.

- The disclosure stated that a "major global customer" of Synergy's [Johnson & Johnson] had obtained the first FDA approval of x-ray sterilization for a Class 3 medical device "paving the way for further conversion."[259]
- On November 5, 2014, Steeves stated on a public earnings call that "We've also reached an agreement with IBA that will allow us to get started with x-ray in the U.S."[260]
- In November, McLean sent a management report to Synergy's PLC board, stating "The U.S. x-ray strategy is now approved. [] However, final selection of the first two sites is on hold, pending network study of the combined STE/SYR network."[261]
- McLean and Tyranski continued to work on implementing the approved x-ray strategy, including seeking letters of interest from customers, locating sites for potential plants, and telling customers that Synergy x-ray capacity would be available in late 2016.[262]
- Synergy customers including Haemonetics, Thermo Fisher, and Zimmer Orthopedic sent products to Däniken for testing on Däniken's x-ray line.[263]
- Synergy told IBA, its would-be supplier of x-ray accelerators, that the x-ray plan was "business as usual, but purchase agreement deadline pushed back to 31 March 2015," pending the anticipated closing of the Steris acquisition, at which point Synergy told IBA it expected to fulfil its purchase agreement with IBA."[264]

E. Evidence concerning the February 2015 termination

- On January 9, 2015, the FTC sent Steris and Synergy second requests.[265]
- On February 19, 2015, McLean met with FTC staff, who explained they had concerns that the transaction would eliminate Synergy's planned x-ray rollout.[266]
- On February 24, 2015 Tyranski reported to his staff "This whole FTC inquiry is going down a rat hole and I'm going to have to communicate to IBA soon that we cannot proceed for the Americas."[267] In response, a Synergy employee wrote "definitely a switch but not surprised based on Andrew's approach with the FTC."[268]
- On February 25, 2015—six days after McLean's meeting with FTC staff—McLean sent a declaration to FTC staff stating that Synergy was ending the x-ray program.[269] McLean attached to his declaration four emails from Synergy customers expressing skepticism regarding the future of x-ray.[270] The circumstances under which at least one of those emails was produced appear most consistent with the emails being generated out of the ordinary course for the purpose of generating favorable documents to rebut the FTC's concerns.[271] McLean testified that he solicited

[259] McLean (Synergy) Transcript, 355:24-356:6.
[260] Hill (Synergy) Transcript, 766:21-25.
[261] McLean (Synergy) Transcript, 356:19-357:4.
[262] Tyranski (Synergy) Transcript, 550:21-552:16.
[263] Haemonetics: Tyranski (Synergy) Transcript, 553:4-8. Thermo Fisher: Tyranski Transcript, 553:23-25. Zimmer: Tyranski (Synergy) Transcript, 554:1-5. Tyranski (Synergy) Transcript, 553:23-25.
[264] Tyranski (Synergy) Transcript, 557:3-10 and 559:6-13.
[265] McLean (Synergy) Transcript, 358:4-6.
[266] McLean (Synergy) Transcript, 358:11-15.
[267] McLean (Synergy) Transcript, 358:22-359:5.
[268] McLean (Synergy) Transcript, 360:5-10.
[269] McLean (Synergy) Transcript, 340:24-341:2.
[270] McLean (Synergy) Transcript, 341:3-6.
[271] One email was from a Johnson & Johnson employee, Vic Baran, who testified that McLean requested he send the email and also requested that Baran double the cost of Johnson & Johnson converting a product group to x-ray sterilization. See McLean (Synergy) transcript, 342:15-343:1. McLean testified that the reason he encouraged Baran

the customer emails because FTC staff had told him on February 19 that they had not seen Synergy documents indicating that any customers had rejected x-ray.[272]

F. Trial testimony and contrary record evidence

- Synergy executives testified that the financial case for x-ray fell far short of the company's financial thresholds for new projects, and in particular a 15% internal rate of return (IRR) when considering the first ten years of the project.[273]
- Synergy executives testified that all Synergy projects must have a "minimum 15 percent IRR [internal rate of return]" when considering only the first ten years of a project to be approved,[274] but that as of September 2014 the x-ray financial plan showed a (ten-year) IRR of only 6.51 percent.[275]
- Synergy executives testified that Synergy's financial model contained "arbitrary" assumptions and was "far from locked down."[276] Hill testified the first time he had seen any financial case for a potential U.S. x-ray expansion was at the September 17, 2014 SEB meeting;[277] his impression at that time was that the financial case was "woeful," lacked "detail behind where the revenue was coming from," and thus was "highly speculative."[278]
- Hill testified that the financial model double counted revenue from Synergy's to-be-closed Lima, OH facility, and that removing the Lima volume would reduce the 10-year IRR to three percent.[279]
- McLean testified that Synergy had no reliable methodology for forecasting x-ray volumes in future years, and "just plugged in some numbers to show that we would be approaching a decent level of capacity utilization in year seven or so."[280]
- Tyranski and McLean both testified that Synergy management were instructed by the SEB to lower capex by $1.5 million per plant, but were unable to do so.[281]
- Hill also testified that all major capital expenditures need[ed] to be put through a thorough "black hat" review process before they received final approval,[282] and that the x-ray expansion had not even begun the review.[283]
- Synergy executives further testified that Synergy's PLC board would have only funded the x-ray expansion if Synergy had attracted "take-or-pay" contracts from x-ray customers, meaning contracts that obligated customers to a certain spend on x-ray.[284] McLean testified that the reason

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to increase J&J's costs associated with switching products to x-ray was because he needed to give his internal stakeholders a reason why Synergy couldn't turn "interest" in x-ray into "commitment." See McLean (Synergy) transcript, 347:24-348:7. Another Johnson & Johnson employee, Joyce Hansen, testified that she, and not Baran, made decisions about whether or not Johnson & Johnson would use x-ray or gamma, and re-affirmed that Johnson & Johnson remained interested in x-ray sterilization and intended to use it to sterilize its products. See Hansen (Johnson & Johnson) Transcript, 49:24-50:7.

[272] McLean (Synergy) Transcript, 399:24-400:1.
[273] Hill (Synergy) Transcript, 661:14-18.
[274] McLean (Synergy) Transcript, 416:12-15.
[275] McLean (Synergy) Transcript, 417:17-19.
[276] McLean (Synergy) Transcript, 407:15-16; 408:23-24.
[277] Hill (Synergy) Transcript, 682:14-17.
[278] Hill (Synergy) Transcript, 683:4-14.
[279] Hill (Synergy) Transcript, 694:3-18.
[280] McLean (Synergy) Transcript, 411:10-12.
[281] McLean (Synergy) Transcript, 422:16-423:1; Tyranski (Synergy) Transcript, 636:25-637:4.
[282] Hill (Synergy) Transcript, 678:15-17.
[283] Hill (Synergy) Transcript, 707:4-13.
[284] Steeves (Synergy) Transcript, 204:1-9; McLean (Synergy) Transcript, 379:3-10.

Synergy killed x-ray was that "we believed in the technology… but our customers fundamentally did not share that enthusiasm."[285]

- McLean testified, "what we were being told by our customers, again and again the more they looked at this project, was the costs to convert [from gamma to x-ray] were going to far exceed any economic benefits in terms of reduced pricing. And [] in general, the cost of sterilization makes up less than three percent of the product cost, so when you weigh up these regulatory and contingency barriers, there is no value proposition that would incentivize us to bear these costs and bear that regulatory risk to make the conversion. It just wouldn't make sense."[286]
- An outside member of Synergy's PLC board, Constance Baroudel, testified that the SEB's approval of Synergy's x-ray strategy did not imply the project would receive funding, as SEB meetings "were only for the management of Synergy," whereas the PLC board "decides on the strategy for the group [Synergy]," and any project with a capex of more than GBP 10 million required PLC approval.[287]
- The FTC's lines of questions implied that its view was that: 1) Synergy's financial threshold was unsupported by Synergy documents and that it made no sense to ignore profits beyond year 10 of an asset when calculating the asset's profitability;[288] 2) No Synergy document produced at trial referenced a "black hat" review;[289] 3) Synergy documents did not support claims that Synergy only considered the first ten-years of profits when measuring the profitability of an investment;[290] and in fact Synergy's planning documents assumed an x-ray accelerator would last for 20+ years;[291] and 4) four of ten sterilization projects approved between 2011 and 2014 had projected (ten-year) IRRs of less than 15% at the time those projects were approved.[292]
- The FTC further questioned whether Synergy had seriously attempted to obtain "take-or-pay" contracts from customers[293] and its questions noted the lack of support for the necessity of contracts in company documents.[294]

G. District court's findings

- The district court sided with the parties, citing the project's financials, lack of customer commitments, and lack of PLC approval.
- The court cited the timing of the death of the x-ray plan as "the best evidence that it was done for legitimate business reasons, as opposed to anti-competitive ones" since "if the merger with Steris was going to prevent Synergy from entering the U.S. market, Synergy would have stopped working on the U.S. x-ray project as soon as the merger was announced in mid-October 2014." Thus "the fact that McLean and Tyranski decided to terminate the project in February 2015, four months after the merger was announced and in the midst of the FTC's investigation, supports the

[285] McLean (Synergy) Transcript, 360:23-361:5.
[286] McLean (Synergy) Transcript, 381:8-22.
[287] Baroudel (Synergy) Transcript, 445:15-17; 446:3-6; 446:15-23.
[288] Hill (Synergy) Transcript, 734:12-735:7.
[289] Hill (Synergy) Transcript, 759:3-6.
[290] Hill (Synergy) Transcript, 735:15-736:4; 737:15-738:15; 739:5-15.
[291] Hill (Synergy) Transcript, 741:1-10.
[292] Baroudel (Synergy) Transcript, 476:12-477:10; Hill (Synergy) Transcript, 752:7-10.
[293] McLean (Synergy) Transcript, 334:4-25; 441:22-442:15; Tyranski (Synergy) Transcript, 507:21-508:2; 551:11-13.
[294] Tyranski (Synergy) Transcript 641:11-13.

conclusion that this was a decision reached by the project managers after serious consideration of all the business factors involved."[295]

Appendix II: Replication of Synergy's financial model

This appendix describes the replication of the contemporaneous Synergy financial model discussed in Section III.C and summarizes the principal sensitivity analyses reported in Table 3. The purpose of the exercise is not to reconstruct Synergy's spreadsheet with mechanical precision from incomplete public materials. Rather, it is to determine whether the model supports testimony that the project was financially weak and unlikely to satisfy Synergy's internal investment criteria.

The replication is anchored in model inputs and outputs described in trial testimony and Synergy documents, including projected capital expenditures, capacity, utilization, profitability, and the model's reported ten-year internal rate of return. Where the public record does not disclose a particular input directly, I calibrate the remaining parameter values to match the known outputs of the actual model. This approach does not eliminate uncertainty, but it does permit a reasonable approximation of the model actually before Synergy management in 2014–2015.

The appendix proceeds in two steps. First, it sets out the baseline replication corresponding to Table 2. Second, it examines several economically plausible modifications to the baseline assumptions—including the treatment of long-lived assets, exchange-rate movements, Lima revenues, and alternative price and margin paths—to assess whether the model was materially more favorable than the trial testimony suggested.

H. Details of replication

I begin with the baseline replication, using the principal model inputs described in the trial record and then calibrating the remaining unknowns to match the reported ten-year IRR.

My replication of Synergy's financial model, described in Section III.C, relied on the following model inputs, taken from trial testimony:

- Synergy assumed an initial outlay of $40.4 million for two plants.[296] I allocate this expense to year 1 of each facility's life.
- Synergy assumed that volumes from its Lima, OH e-beam plant would transfer over to its Indiana x-ray facility.[297] I assume these revenues would have resulted in $4 million in revenue at the Indiana facility beginning in the first year of operation.[298]
- Synergy assumed that capacity utilization that would increase to 100% over the course of the first six years of a facility's life.[299] I model Synergy's Texas facility as operating at 0% of capacity in year 1, 1/6 of capacity in year 2, 2/6 of capacity in year 3, and so on. I model Synergy's Indiana facility as adding volume at the same rate as the Texas facility until its capacity is reached.

[295] Decision, at 39-40.
[296] Hill (Synergy) Transcript, 749:20-22.
[297] Tyranski (Synergy) Transcript, 540:19-23.
[298] In 2015, Synergy North America operated 4 e-beam facilities and 2 EO facilities and had $30 million in revenues. I assume the Lima plant accounted for roughly 13% of revenues, or slightly less than 1/6 of total North American revenues, consistent with its age. Different assumptions on Lima's revenues do not change my conclusions.
[299] Tyranski (Synergy) Transcript, 598:8-14.

- Synergy assumed that it would capture a 15% share of U.S. gamma sales with four x-ray plants.[300] Synergy estimated that total gamma capacity in the U.S. was 150 million cubic feet.[301] Therefore, I model the capacity of each x-ray plant to be $150 \text{ million} * 15\% * \frac{1}{4} = 5.625 \text{ million cubic feet}$.
- Synergy assumed the price of x-ray would be $2.50/cu. ft.[302] I use this price to calculate the revenue associated with a given capacity utilization.
- Synergy's most recent publicly announced profit margin was 34.4%.[303] I apply this margin in assuming that $1 in Synergy revenue would result in 34.4 cents of Synergy profit.
- I calibrate an annual fixed cost (which could include, e.g., an allocation of central management costs or property taxes), set to equate the project's 10-year IRR to that generated by Synergy's financial model in 2014 and to match other model outputs as closely as possible.
- For the purposes of replicating Synergy's terminal value calculation, I used a 2% annual growth rate, as Synergy did per the trial record, and calibrated an 11.9% discount factor to match the 15.85% IRR (including terminal value) that appears in the trial record. This discount factor is not used other than when accounting for a terminal value.
- My conclusions are robust to different interpretations of the trial record, as my results do not significantly change under different assumptions.

In sum, my replication of Synergy's financial model depends on seven inputs:[304] the upfront cost of each facility, the "starting" volume at an Ohio facility that would be ported over from Synergy's Lima e-beam facility, the rate at which volumes would grow until capacity was reached, the total capacity of each facility, the price of x-ray, the portion of x-ray revenue that increased Synergy's profits (with the remainder being variable costs), and the annual fixed cost associated with each facility. The first six of these are taken directly from the trial record.

Of these six inputs, the trial record contains exact values for two (the initial cost of the x-ray facilities and the price of x-ray) and precise but approximate values for three more (the total capacity,[305] the rate at which the facilities would reach capacity,[306] and the volume to be transferred from Synergy's Lima, OH e-beam facility[307]). For the sixth, Synergy's margin on x-ray does not appear in the trial record, so I have assumed that it would match Synergy's company-wide margin, as the costs of operating an x-ray facility are likely to be comparable to the costs of operating a gamma facility; while this value is exact and comes from Synergy's public financial filings, I cannot rule out that Synergy would earn a different margin on its x-ray facilities as compared to its gamma and ethylene oxide facilities. However, small changes in the margin associated with the planned x-ray facilities do not change the conclusions of the model.

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[300] McLean (Synergy) Transcript, 316:6-18.
[301] McLean (Synergy) Transcript, 408:7-15.
[302] McLean (Synergy) Transcript, 415:7-14.
[303] Synergy Annual Report, 2015.
[304] Two additional inputs are needed to replicate Synergy's calculation of IRR including terminal value: the rate of revenue growth beyond year 10 and the annual discount factor applied beyond year 10. The former is given as 2% in the trial record. I calibrate the latter at 11.9% to match the 15.85% IRR (including terminal value) referenced in the trial record. Neither input affects any calculation other than the IRR including terminal value.
[305] Synergy projected that two x-ray facilities could capture 15% of gamma volume, and precise but approximate estimates for this volume appear in the trial record.
[306] Synergy projected that the facilities would reach capacity in six years; based on this, I assume a uniform growth rate which reaches 100% in six years, however it is possible that Synergy's model assumed non-uniform growth.
[307] The trial record contains estimates of the 10-year IRR with and without Lima volumes, which allow precise calibration of the value of Lima volumes. Moreover, the result of $4M per year in Lima volume matches information on e-beam volumes from other sources in the trial record.

The seventh and final model input—the annual fixed costs associated with an x-ray facility—does not appear in the trial record. Instead, it is calibrated so that model outputs match values that do appear in the trial record. Specifically, I assume an annual fixed cost per facility of $1,033,000, or about 9.2% of the long-run revenue each facility was projected to earn from x-ray, as this value exactly reproduces the 6.51% ten-year IRR which appears in the trial record, given other assumptions. In that sense, this value is implied by the other six values, though estimation error in any of those values would cause the annual fixed costs to be incorrectly estimated as well.

As described above, the conclusion that Synergy's x-ray was at or near Synergy's claimed IRR threshold of 15% even before considering ways in which Synergy's model was conservative is robust to alternative model inputs. While changes to model inputs increase or decrease the model's IRR, large negative changes are needed to robustly push the project's IRR below 15%, particularly when adjusting for conservative modeling assumptions used by Synergy.

I. Sensitivity analyses and alternative scenarios

1. Favorable exchange rate fluctuations achieved two-thirds of Synergy's stated capex reduction goal

Synergy management testified that they were asked to reduce capex by $1.5 million per facility following the September 2014 SEB meeting, and did not identify other specific feedback regarding the project's finances.[308] Synergy achieved approximately two thirds of its capex reduction goal solely through favorable exchange rate fluctuations between the September 17, 2014 SEB meeting and Synergy's February 24, 2015 decision to kill its planned x-ray expansion. The x-ray accelerators Synergy planned to purchase were priced in Euros while Synergy, a U.S. company, would have paid for them in dollars. The dollar strengthened by approximately 18.4% between the September 2014 SEB meeting and Synergy's termination of its x-ray plans in late February, 2015, resulting in the dollar cost of the accelerators decreasing from $6.6 million in September 2014 to $5.6 million in early March 2015 (the date closest to the death of Synergy's x-ray expansion for which data are available).[309] The reduction in capex due to the more favorable exchange rate increased the x-ray project's IRR from 14.5% to 15.2% (when assuming no other changes).

Decreasing the capex by an additional $500 thousand per facility (to bring the total capex reduction to $1.5 million per facility, as requested by Synergy executives) would have further increased IRR to 15.5%. This modest return from the additional capex reduction requested by Synergy executives—and the lack of other feedback regarding Synergy's financial model—is consistent with the project *already* having an IRR at or near the level required for viability, and is inconsistent with testimony by Synergy executives that the financial model was "woeful" and showed returns far below what would be needed for approval.[310] If executives saw the model as "woeful," they would have been incentivized to either kill the project outright or to ask for more dramatic improvements.

[308] Tyranski (Synergy) Transcript, 610:5-12.
[309] The USD:EUR exchange rate was 1.2829 on 9/20/2014 and 1.0844 on 3/7/2015. Synergy projected each x-ray accelerator to cost EUR 5.174 million.
[310] Hill (Synergy) Transcript, 683:4-6.

2. The model conservatively assumed x-ray would be significantly discounted relative to gamma

Synergy's financial model assumed a price of $2.50 per cu. ft. for the life of the x-ray facilities.[311] In 2015, gamma sterilization was priced between $3 and $4 per cu. ft.[312] This means that Synergy's model assumed that Synergy x-ray would offer between a 20% and a 40% discount off of then-prevailing gamma rates. Evidence indicates that the price of gamma has increased, potentially dramatically, since 2015.[313] Synergy's model did not account for any growth in the price of x-ray sterilization, at least until 2027, when Synergy assumed that x-ray revenue would grow by 2% per year in calculating the terminal value of the x-ray facilities.[314] Synergy's model is *extremely* conservative in this regard; merely projecting the price of x-ray to grow to $4 over ten years—i.e., so that the price of x-ray in 2026 would be equal to the high-end estimate of the price of gamma in 2016, but making no other changes—would increase the IRR associated with the x-ray project to 19.7%.[315] Allowing the price of x-ray to grow at 5% per year over the life of the facilities (while maintaining the model's initial 20-40% discount off of gamma prices) would increase the project's IRR to 20.7%.

Synergy executives testified that the financial model was conservative in its assumptions on the price of x-ray. McLean testified that Synergy intentionally modeled the price of x-ray to be below that of gamma "to be a little bit conservative."[316] McLean also told Steeves that the number in the projections were "bolted down" but that "there were elements in the model that were highly conservative [and] I am hoping we do not misinterpret a conservative business case with not being on top of the numbers."[317] Synergy documents indicated that, if anything, x-ray might be able to sustain a price *premium* over gamma; for instance, a July 2014 presentation prepared by McLean's stated "Experience from Däniken demonstrates that customers are willing to pay a premium for x-ray if they have unique DUR, temperature, turnaround time, or other specific requirements."[318]

Synergy may well have had good business reasons to model the price of x-ray to be well below the gamma price, i.e., to reflect the risk inherent in a new technology. However, the model's IRR of approximately 15% even under its highly conservative pricing assumptions contradicts Synergy testimony that the model projected "woeful" financial returns.

3. The model's treatment of Lima e-beam revenues is consistent with economics

Synergy's x-ray model included revenues intended to be transferred from its soon-to-be-closed e-beam facility in Lima, OH to its x-ray facility in Decatur, IN. The trial record indicates that Synergy projected these revenues to begin immediately.[319] Synergy executives testified that the inclusion of these revenues

[311] McLean (Synergy) Transcript, 414:23-415:1.
[312] McLean (Synergy) Transcript, 415:7-14.
[313] See note 116, *supra*. See also evidence on the increasing profit margin of Steris, Section III.B, *supra*, which is most consistent with Steris being able to increase its prices for sterilization services.
[314] Hill (Synergy) Transcript, 687:10-11.
[315] This calculation assumes that the price of x-ray would grow by 2% per year thereafter, consistent with Synergy's financial model.
[316] McLean (Synergy) Transcript, at 415:7-14.
[317] McLean (Synergy) Transcript, 326:19-327:3.
[318] McLean (Synergy) Transcript, 289:17-23.
[319] Tyranski (Synergy) Transcript, 540:19-23.

was a double counting error, since Synergy already had the revenues, and thus they would not be incremental to new x-ray facilities.[320]

As a matter of economics, it would be appropriate to count the Lima revenues in the x-ray model if (and only if) Synergy had no good alternative means to keep the revenue. Synergy's lease at its Lima facility had expired and Synergy documents indicated plans to shutter the facility and to move the volume to its new Decatur facility.[321] Decatur is located 53 miles from Lima. Synergy's next closest plant, in Saxonburg, PA, was located 264 miles from Lima, and was co-located with a Bayer facility,[322] meaning that a portion of Saxonburg's volume was likely dedicated to Bayer.[323]

Saxonburg came online in March 2015. In January 2015, Synergy sought to extend the end date of its Lima lease from October 2016 to October 2017 to "buy us time for the Steris transaction and x-ray strategy,"[324] which suggests that Synergy did not see transferring the Lima volumes to Saxonburg as a viable strategy. Synergy's next closest facility, in Chester, NY, was 587 miles away from Lima. Per the FTC's complaint, sterilizers generally serve customers located within 500 miles of facilities,[325] indicating that Synergy's Lima customers may have been unwilling to have product sterilized at Chester. If the planned Decatur x-ray facility represented Synergy's best chance to retain the Lima customers after the Lima facility was closed, as a matter of economics if would be appropriate to count the Lima revenue towards the profitability of the x-ray plan, contrary to the testimony of Synergy executives.[326]

Even when considering, for the sake of argument, the executives' testimony that including Lima revenues was an "error," removing the estimated Lima revenues (but making no other change) lowers x-ray's IRR from 14.5% to 12.8%.[327] Removing Lima revenue from a more aggressive version of the financial model, under which the price of x-ray grows at 5% per year and Synergy's margin grows at 2% per year, reduces the IRR from 23.0% to 21.2%. In short, while the inclusion of the Lima revenues was likely appropriate, their exclusion would not have materially worsened x-ray's profitability.

4. Testimony that Synergy ignored profits beyond year ten of a project is not consistent with economics or Synergy documents

Synergy executives testified that Synergy customarily considered only the first ten years in evaluating the profitability of a project, and ignored any profits that accrued in year 11 or beyond.[328] Synergy claimed that it did so because "in the long run, we are all dead. And anything over ten years is very much in the

[320] Hill (Synergy) Transcript, 694:7-14.
[321] Tyranski (Synergy) Transcript, 540:19-22.
[322] The Google Maps street view shows a Bayer facility connected to the Steris facility in Saxonburg; see https://tinyurl.com/4ja7j2rj.
[323] For instance, Synergy's Petaluma, CA e-beam facility was co-located with Labcon, who committed to providing volumes to the facility. Tyranski (Synergy) Transcript, 636:8-18.
[324] Tyranski (Synergy) Transcript, 540:13-541:5.
[325] Complaint, ¶47.
[326] It is possible the next best alternative to transferring the volume to a new x-ray facility in Indiana was extending the Lima lease and keeping the volumes in Lima. See Hill (Synergy) Transcript, 747:24-748:1. Had Synergy pursued this option, it would have incurred additional costs from keeping Lima open, costs which Synergy executives had evidently decided were prohibitive, given their realized decision to close Lima and move volumes elsewhere.
[327] At trial, Synergy executives testified that removing Lima revenue halved the IRR, on the basis of taking the ten-year IRR, which ignores revenues from 2027 onwards, from "6 percent to 3 percent" (Hill (Synergy) Transcript, 694:17-18). In my replication of Synergy's model, removing Lima revenues takes the ten-year IRR from 6.51% to 3.7%, which validates my replication being a reasonable approximation of Synergy's financial model.
[328] Hill (Synergy) Transcript, 772: 2-7.

long run."[329] My replication of Synergy's financial model indicates that considering only the first ten years of profits lowers x-ray's IRR from 14.5% to 6.51%,[330] and thus caused the profitability of the project to be significantly understated relative to an accurate and appropriate accounting that considered profits generated over the full lifespan of new x-ray facilities.

Synergy's claimed irrelevance of profits from year 11 on does not withstand scrutiny. Synergy forecast the lifespan of an x-ray facility to be between 20 and 30 years,[331] and the Däniken x-ray facility, constructed in 2010, remains open in August 2025. Synergy forecast a six year "ramp-up" to a new x-ray plant reaching capacity, meaning that limiting a financial model to consider only the first ten years would account for only four years of operation at capacity.

Ignoring profits beyond year ten is inconsistent with profit maximization or economics.[332] As an example, consider a project requiring a $20 million upfront payment that would produce a profit of $100 million in year 11 (and no other profits). The project would be a clear money loser when considering only the first ten years (i.e., it would lose $20 million over the first ten years), but a clear winner over an 11 year horizon (with an IRR of 15.8%, i.e., similar to the IRR associated with Synergy's x-ray project).[333] Economics teaches that a profit-motivated firm, like Synergy, would have every incentive to consider all profits that would accrue from a project, including those beyond year 10.[334]

The practice of ignoring profits beyond year 10 was not memorialized in Synergy documents.[335] Indeed, the standard financial template designed by Synergy executives included both a ten-year IRR and a long-run IRR (with a terminal value).[336] Synergy's past actions also were not consistent with considering only the return in the first ten years of an investment. Synergy documents indicated that four of ten recently-approved Synergy projects had projected (ten-year) IRRs of less than 15 percent at the time they were approved.[337] If Synergy had considered only the first ten years of those projects, and had required an IRR of 15%, it would not have approved funding for those projects.

5. Testimony that the model's "Terminal Value" was incorrectly applied is unavailing

Synergy executives testified that the x-ray financial model was unreliable because it included a terminal value term—meaning a proxy for profits in year 11 and beyond—that assumed x-ray would deliver

[329] Hill (Synergy) Transcript, 660:4-7.
[330] In fact, Synergy's model calculated the IRR when ignoring years profits beyond year 10 to be exactly 6.51%. I exactly match Synergy's number because I calibrated a model input—the amount of fixed costs per period—to equate the 10-year IRR implied by my replication of the Synergy model to 6.51%. Different assumptions regarding fixed costs or other model inputs would not change any of my conclusions.
[331] Synergy itself modeled the x-ray accelerator as having a 20-year lifespan and the building and conveyor system associated with an x-ray plant as having a 30-year lifespan. See Hill (Synergy) transcript, 741:20-742:4.
[332] See, for example, Brealey, Richard A., Stewart C. Myers, Franklin Allen, and Alex Edmans. Fundamentals of Corporate Finance. 9th ed. New York: McGraw-Hill Education, 2018, at 241-242 (stating that the "net present value rule states that managers increase shareholders' wealth by accepting projects that are worth more than they cost" and that "the net present value rule works for projects of any length.").
[333] That is, $-20M + \frac{100M}{(1+15.8\%)^{11}} = 0$.
[334] See, for example, Robert S. Pindyck & Daniel L. Rubinfeld, Microeconomics, 8th ed. (Pearson, 2013), chap. 8 "Profit Maximization and Competitive Supply," §8.2 Do Firms Maximize Profit?, p. 272 ("The assumption of profit maximization is frequently used in microeconomics because it predicts business behavior reasonably accurately and avoids unnecessary analytical complications.")
[335] Hill (Synergy) Transcript, 735:25-738:10.
[336] Hill (Synergy) Transcript, 660:21-661:9.
[337] Baroudel (Synergy) Transcript, 476:12-477:3.

revenues "into perpetuity, so that means forever and ever and ever, and that clearly is not realistic."[338] My replication of Synergy's financial model allows me to estimate Synergy's IRR without relying on any terminal value calculation, and thus to assess Synergy's methodology.

The executives are correct in that economics does not support modeling the profitability of an asset with a 20-30 year life as though it would produce returns forever. However, the practical effect of this modeling choice was vastly overstated at trial, as when a Synergy executive testified that "a terminal value goes out thousands and thousands of years into the future."[339] Synergy's terminal value calculation discounted future profits,[340] and it appears that Synergy management applied a high annual discount rate of approximately 11.9%—about 50% higher than Synergy's contemporaneous corporate discount rate of 7.9%[341]—to future profits, which had the effect of assigning almost no value to revenues that were projected to be realized more than a few years into the future. For instance, at an annual discount rate of 11.9%, profits to be realized 6 years into the future would be discounted by half, and profits to be realized 15 years into the future would be discounted by more than 80%. Profits "thousands and thousands of years into the future" would be discounted to effectively zero.[342]

Synergy additionally assumed that each facility's x-ray revenues would grow in perpetuity at 2% per year, which Synergy executives testified was "clearly not realistic."[343] In fact, a 2% growth rate was Synergy's stated standard modeling assumption in 2015, as described in its Annual Report (describing a 2% "perpetuity growth rate" for Synergy AST).[344] Synergy appears to have applied a common methodology to calculate the project's terminal value, under which the terminal value equals the annual profit flow divided by the discount factor minus the projected growth rate.[345] As mentioned, my replication of Synergy's financial model implies that Synergy applied a discount rate of 11.9%,[346] which is well *above* its stated corporate-wide discount rate of 7.9%.[347] The higher discount rate assumed by Synergy *lowers* the terminal value and thus has the effect of compensating for Synergy's assumed perpetual revenue from x-ray facilities.

Based on my replication of Synergy's model, which calculates out-year profits directly rather than through the use of a terminal value, Synergy's terminal methodology appears to reasonably approximate the correct value of IRR over the life of the project, in that Synergy's IRR (including terminal value) was 15.85% whereas in my replication the IRR over an estimated 25-year life of the facilities was 14.50%. Thus, the use of a perpetual value IRR at most modestly overstated the project's IRR, contrary to testimony of Synergy executives.

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[338] Hill (Synergy) Transcript, 687:7-14.
[339] Hill (Synergy) Transcript, 738:7-10.
[340] Hill (Synergy) Transcript, 738:18-21.
[341] Synergy 2015 Annual Report, at 81.
[342] For instance, at an 11.9% annual discount rate, profits 2,000 years into the future would be discounted by a factor of 2.2 * 10^-98. As a point of reference, there are approximately 10^80 atoms in the universe, meaning that the proportion of profits "thousands of years into the future" that would contribute to IRR is less than the ratio of one atom to all of the atoms in the universe.
[343] Hill (Synergy) Transcript, 687: 10-14.
[344] Hill (Synergy) Transcript, 658:3-6.
[345] See, for instance, Brealey, Richard A., Stewart C. Myers, Franklin Allen, and Alex Edmans. Fundamentals of Corporate Finance. 9th ed. New York: McGraw-Hill Education, 2018, at 215-216.
[346] 11.9% is the discount rate that produces an IRR (inclusive of terminal value) of 15.85%, consistent with Synergy's financial model. See Hill (Synergy) Transcript, 740:8-11.
[347] Synergy 2015 Annual Report, at 79.

6. The model conservatively projected slow volume growth

Synergy executives testified, and the court cited as persuasive, that Synergy's x-ray model was "the product of guesswork and assumptions."[348] In this, they appear to refer to the rate at which x-ray plants would attract new business. Synergy's financial model assumed that its Texas x-ray plant would reach capacity in year seven, and its Indiana plant earlier (owing to the Lima volumes that would shift to Indiana). The realized experience of Steris's x-ray plants suggests Synergy's modeling assumptions were, if anything, conservative. In particular, Steris's Venlo x-ray plant opened in 2022, and in 2023—about one year later—Steris announced it would build a second x-ray facility on the same site and stated in an earnings call that Venlo was "very well-received" with "significant positive margins,"[349] suggesting that Venlo was on track to reach capacity well before its seventh year. Likewise, Steris's use of x-ray throughout its network, as described in Section III.A, indicates broad customer acceptance of x-ray sterilization.[350] Synergy had continued to move forward with its x-ray plans over the course of two years, suggesting that it saw significant demand for x-ray sterilization. However, a delay in the time needed for an x-ray facility to reach capacity would indeed have worsened the financial returns of the x-ray project. For instance, if it took 10 years instead of 6 for the facilities to reach capacity, with no other changes, the IRR of Synergy's x-ray expansion would decrease from 14.5% to 12.2%.

Evidence indicates that Synergy was aware that converting customers to x-ray could be a gradual process, and moved forward with its x-ray expansion nonetheless. For instance, Tyranski testified that Synergy's SEB was aware that it would take time for medical device manufacturers to convert products to x-ray sterilization,[351] with the plan being to initially fill volume at Synergy's new facility by sterilizing non-medical products and less-regulated Class 1 medical devices.[352] Moreover, uncertainty regarding the arrival rate of x-ray customers was accounted for in Synergy's financial model through the gradual ramp-up of x-ray revenue at Synergy facilities.

7. The model conservatively assumed no growth in Synergy's margin on x-ray sales

Synergy's financial model appears to assume that Synergy would earn a constant margin on x-ray sales over the life of the facility, and in replicating their model I assumed a margin of 34.4%, taken from Synergy's 2015 Annual Report. The combined firm's margin increased dramatically following the merger, from 32.4% in 2017 (the first full post-merger year) to 41.6% in 2025.[353] Holding Synergy's margin fixed while allowing the price of x-ray to increase implicitly assumes that its costs would increase in lockstep with its revenues. A more likely scenario is that Synergy's costs would stay roughly constant as its prices increased to match those of gamma, which would cause its profit margin to increase. Allowing for 5% annual growth in the price of x-ray and also allowing Synergy's profit margin to increase steadily to 41.6% by FY 2025—i.e., to match Steris's operating profit margin in 2025—increases the project's IRR to 23.1%.[354]

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[348] Decision, at 17.
[349] Steris 2023 Q1 earnings call.
[350] See Section III.A, *supra.*
[351] Tyranski (Synergy) Transcript, 516:25-517:12.
[352] Tyranski (Synergy) Transcript, 518:22-519:5.
[353] See Section III.B, *supra*.
[354] In 2015, Synergy likely had no reason to expect its margin to increase dramatically in the next ten years, but an increase in price would typically also result in an increased margin, thus making a price increase even more profitable than it would be with a constant margin. Thus, an assumption of a constant margin exacerbates the extent to which the price assumptions embedded in Synergy's model are conservative.