*The Merger Of Thermo Fisher Scientific Inc. & Life Technologies™ And Its Effect On Consumer Surplus A Cournot Model Approach*

A thesis submitted

by

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## Abstract

In 2013, Thermo Fisher Scientific Inc. proposed to acquire Life Technologies™. The merger of these two giants in the biotechnology industry drew concern from US, European and Chinese regulators who saw it as an opportunity for Thermo Fisher to attain monopoly control of the market - allowing them to raise price and reduce quality for consumers. Thermo Fisher was subsequently sued for anti-trust purposes, but settled the case after divesting their cell culture media/cell culture sera, gene modulation and magnetic beads product brands to GE Healthcare.

This research sets out to investigate the impact the merger had on the market for biotechnology products and services. Using the Cournot theory of economic competition, I develop a model to calculate approximate market share, quantity output and cost of production for Thermo Fisher, Life Technologies and their competitors. From the model, I can draw conclusions on how consumer surplus is affected by the merger, the efficacy of the settlement in preventing monopolization and what cost synergies the merged firm needs to produce at in order to leave consumers no worse off. This research finds that the merger certainly reduces consumer surplus and the settlement did little to prevent Thermo Fisher from acquiring a majority share in the markets for cell culture media/sera, siRNA reagents or polymer-based magnetic beads.

## *I. Introduction*

The market for biotechnology products and services has been a rapidly evolving field over the past two decades. As the pace of technological development continues to skyrocket, biotech firms have been constantly innovating to expand the reach of scientific inquiry. While competition has increased to provide research and pharmaceutical laboratories with the latest tools and techniques, the industry has seen a series of mergers and acquisitions that have changed the landscape for market competition. In 2013, the biotechnology company Thermo Fisher Scientific Inc. proposed to acquire Life Technologies™ for $13.6 billion. Following the merger proposal, the Federal Trade Commission sued Thermo Fisher claiming the merger would violate both the Clayton Act and the Federal Trade Commission Act for anti-trust purposes. The Chinese Ministry of Commerce (MOFCOM) as well as the European Union followed, lodging anti-trust complaints against the merger. The suit alleged that in the areas of cell culture sera, cell culture media, polymer-based magnetic beads and siRNA reagents the merger would allow Thermo Fisher to acquire monopoly control of the market, thus letting them raise the price and reduce quality for consumers (US Federal Trade Commission – *Complaint*, 2014). After months of negotiation, the FTC, MOFCOM and the European Union conditionally approved the merger after Thermo Fisher agreed to divest portions of the company (Mayer, 2014). In the settlement, Thermo Fisher is selling off its magnetic beads business (Sera-Mag**™**), gene modulation business (Dharmacon**™**) and its cell culture media/sera business (HyClone®) to GE Healthcare (US Federal Trade Commission – *Decision and Order,* 2014). While the settlement was arranged to hypothetically increase market competition and prevent monopoly output and pricing that may not have played out in reality.

This research sets out to investigate how the market for biotechnology products and services has changed after the merger by calculating an approximate market share of the combined companies in the respective product areas in contention and evaluating the resulting consumer surplus. Using the Cournot theory of competition, I will construct a model to predict cost, quantity and combined market shares at unitary demand elasticity in the cell media/cell sera, polymer-based magnetic beads and siRNA reagent product categories given data outlining current market shares for Thermo Fisher and Life Technologies. After calculating the output and market share, I will calculate the cost of production necessary for the new Thermo Fisher Scientific Inc. to increase consumer surplus. The model will also determine the efficacy of the settlement decision by comparing market share, cost and quantity produced in a world where Thermo Fisher was allowed to keep all portions of the company and where it was forced to sell them off.

This work is timely as research scientists in all areas (academic, pharmaceutical, medical etc) are make purchasing decisions regarding the prices they are offered and the options they have now that two of their largest providers have joined forces. Items like cell media/cell culture sera, polymer-based magnetic beads and RNA reagents can be common denominators across almost all research laboratories and being able to make more informed purchases is critical when grant-funding for life science research is at an all-time low (Boadi, 2014).

## *II. Background*

Thermo Fisher Scientific Inc. ("Thermo Fisher") is a multinational biotechnology product development company head quartered in Massachusetts, USA. It was formed after the merger of Thermo Electron and Fisher Scientific in 2006 and has quickly become one of the global leaders in facilitating research across the entire spectrum of experimental sciences. Thermo Fisher's activities range from delivering laboratory products and services, life science solutions, specialty diagnostics and analytical instruments (European Commission, 2013). Life Technologies ("Life Tech") is a global biotechnology company headquartered in California that specializes in analytical instruments and life sciences laboratory consumables like genome sequencing products and services. Life Tech was borne out of the merger between Invitrogen Corporation and Applied Biosystems Inc. in 2008. Both Thermo Fisher and Life Tech have a strong presence in the areas of cell culture, molecular biology, particle research and protein biology (European Commission, 2013). Thermo Fisher and Life Tech primarily sell their products to research laboratories at universities/government agencies, private sector pharmaceutical, biotechnology and bioproduction companies as well as hospitals/clinical diagnostic laboratories. Thermo Fisher and Life Tech are not alone in these product areas or customer bases; there are a larger number of multinational competitors for life science research products. The most prominent include Sigma-Aldrich, which competed with Thermo Fisher to acquire Life Tech (Welch, 2013), BioRad, Qiagen, Merck Millipore, Promega, Lonza and GE Healthcare.

On April 14th, 2013, Thermo Fisher proposed to acquire Life Tech for $13.6 billion and purchase 100% shares of the company. The Federal Trade Commission was concerned that the acquisition, as proposed, would eliminate competition in the market and would allow Thermo Fisher to exercise monopoly power to raise price and reduce quality for consumers. The existing market was already fairly concentrated and consumers currently benefitted by leveraging Thermo Fisher and Life Tech against one another to receive the best price and highest quality product. The FTC proceeded to sue Thermo Fisher under two different legal precedents. First, Section 7 of the Clayton Antitrust Act of 1914 which covers areas where the effect of mergers and acquisitions substantially lessen competition and second, Section 5 of the Federal Trade Commission Act of 1914 which prohibits "unfair or deceptive acts or practices in or affecting commerce" (US Federal Trade Commission – *Complaint,* 2014). The FTC and European Commission identified the market areas where competition would be severely lessened if the acquisition was completed: siRNA reagents, cell culture media, cell culture sera and polymer-based magnetic beads (US Federal Trade Commission - *Analysis Of Agreement Containing Consent Order To Aid Public Comment,* 2014).

siRNA reagents (small/short interfering ribonucleic acid) are double stranded RNA molecules, usually 21-25 base pairs in length, that are used to study gene function by selectively turning off, or "silencing," gene expression and inhibiting protein synthesis. siRNA reagents are able to do this by forming a multi-subunit protein complex in the cell called the RNAi induced silencing complex (RISC complex). The RISC complex is able to bind to messenger RNA (mRNA) at specific complementary sequences, unwind it and ultimately degrade it. The messenger RNA carries a specific nucleotide sequence from a certain gene to allow for protein production, thus the interruption of this process results in no/limited expression of a gene (Choi and McCallum, 2013). Scientists can use siRNA to make predictions about gene function which can be used to better understand cellular interactions of infectious disease pathways, use as a therapeutic agent in drug delivery and provide a range of knowledge in connection with agricultural research and crop production. siRNA reagents can be bought both individually or in "libraries," which are collections of reagents used to understand groups of interrelated genes. There are two other forms of RNA interference techniques called short hairpin RNA (shRNA) and microRNA (miRNA), but are used substantially less than siRNA methods due to cost and efficiency (European Commission, 2013).

Upon the discovery of siRNA techniques in the late 1990s, several firms jumped to develop the technology at the highest efficiency and lowest cost. One of the early pioneers in RNA interference was Dharmacon Research Inc. They had been working primarily with synthetic RNA oligonucleotides but quickly became a leader in siRNA design for their potency and specificity, their most famous being the SMARTpool knockdown reagent (BIONITY, 2005). In 2004, Dharmacon was acquired by then Fisher Scientific before merging with Thermo Electron. Thermo Fisher's Dharmacon™ brand represented the largest player in the siRNA market pre-merger controlling close to 40-50% of the market. Life Tech's Ambion® brand was its closest competitor with around 20-30% of the market (European Commission, 2013). The market for siRNA reagents is unique in that it is heavily influenced by intellectual property rights. In order to create the siRNA duplex design of a certain length, an individual must acquire a Tuschl patent for which the Massachusetts Institute of Technology (MIT) is the licensing agent. Thermo Fisher and Life Technologies are two of only four companies (the other two being Qiagen and Sigma-Aldrich) who have secured these licenses. While some firms without a Tuschl license have been able to manufacture siRNA, like Integrated DNA Technologies (IDT), the patent provides a massive competitive advantage in the market as a stamp of performance and reliability (European Commission, 2013). This barrier to entry to compete in the siRNA market has sounded alarms in response to the merger of Thermo Fisher and Life Tech as they represent half of manufacturers who hold the license to produce siRNA reagents.

Cell culture media are mixtures of vitamins, ions, salts, sugars, amino acids and trace elements that are used to support the growth of cells. The cell media market can be divided into four different product markets. First, it is divided on the basis of customer groups – bioproduction customers and the research sector. Bioproduction firms actively produce biologics-based drugs including protein-based therapeutics, vaccines, gene and cell therapies (McKown and Coffman 2002) whereas the research sector is involved in a range of scientific pursuits to better understand physical, chemical and biological processes. The two groups have significant differences in terms of purchasing patterns, pricing and expected quality in cell media (European Commission, 2013). Second, if the media is solid in liquid or dry powder form. Third, if the media is standard basal media, custom media or proprietary media, and fourth if the media is chemically or non-chemically defined. These different variations of media delivery all entail different pricing, performance, suitability and equipment (European Commission, 2013). This research will evaluate market share and costs relative to the cell media market as whole (solid/liquid, specialty and chemically modified) but will segment based on the customer groups.

Cell culture sera are liquids derived from animal blood that are rich in nutrients, proteins and growth factors to propagate the growth of mammalian cells. Cell serum is often used in conjunction with cell media to complement growth factors for cells. Serum is most commonly derived from cattle with varieties including fetal bovine sera, adult bovine sera, newborn calf sera, calf sera, equine sera, and porcine sera. Fetal bovine serum (FBS) is preferred by scientists and researchers due to its high quality and low contamination risk (European Commission, 2013). The market for cell culture sera can be divided into three markets. The first is on the different customer groups between the bioproduction and research sectors outlined above. Second is the animal from which the serum comes from (calf, adult bovine, bovine fetus, horse etc) and third is the geographic location from which the sera arrives – Australia, New Zealand, United States, Canada and South America. This research will only look at purchase of the FBS strain, as it is the most highly preferred, and purchases from within Canada and the US but will retain the customer segmentation between the bioproduction and research sectors. Life

Technologies' Gibco® brand is the strongest player in the cell culture sera and cell media market with market shares in excess of 40% and Thermo Fisher's HyClone® brand is a significant competitor controlling about 20% of the market. The merger between the two drew concern from regulators because they are two of only three substantial competitors in the cell media/sera market. Sigma-Aldrich is the next closest competitor with a market share of around 15% and the remaining firms have considerably smaller market shares (US Federal Trade Commission – *Complaint*, 2014).

The final product area in contention was the particle bead market. These are spherical beads ranging from 20 nanometers to 2,000 microns in diameter that can be magnetic, plain, fluorescent or dyed. Magnetic beads are super-paramagnetic particles (responds to a magnetic field while not retaining any innate magnetism) used to extract nucleic acid, protein in cell sample preparation and immunoassays (European Commission, 2013). Magnetic beads are most commonly either polymer-based or silica-based which give it its super-paramagnetic nature. According to customers, polymer-based magnetic beads "are generally more suitable for certain downstream applications, such as diagnostics, since the magnetic content of the particles is more stable… and have a density closer to $1g/cm^3$, which prevents them from fast sedimentation, which is important for our application" (European Commission, 2013). Magnetic beads are primarily sold to Original Equipment Manufacturers ("OEMs"), who purchase in high volumes via long-term contracts, for inclusion in their own kits and instruments (European Commission, 2013. The preference for polymer-based magnetic beads amongst OEMs has lead previous market investigation and this own research to treat it as a separate product market distinguished from other types of magnetic beads. Life Technologies' Dynabeads® brand is a clear market leader in polymer-based magnetic bead sales controlling over 50% of the market share with

Thermo Fisher's Sera-Mag™ brand hovering around other competitors controlling around 10-20% (European Commission, 2013). Intellectual property rights also acts as a significant barrier to entry in the market for magnetic beads as Thermo Fisher and Life Tech both retain several enforceable patents relating to the composition and manufacturing of polymer-based magnetic beads. Potential competitor Promega (which currently is not active in supplying polymer-based magnetic beads) remarked that "new competitors have high barriers to innovate and smaller companies do not have the ability to innovate due to lack of access to the IP" (European Commission, 2013). These barriers to entry draw concern for the merger between Thermo Fisher and Life Tech as it concentrates a market that many competitors already have trouble entering.

To ameliorate the fears of constricted market competition and potential monopolization of several sectors of life-science products, the FTC, European Commission and MOFCOM proposed a divestiture of Thermo Fisher's product divisions of concern. In order to complete the acquisition of Life Technologies, Thermo Fisher Scientific would need to divest its cell culture business, HyClone®, gene modulation business, Dharmacon™, and magnetic beads business, Sera-Mag™, into the possession of GE Healthcare. GE Healthcare was chosen as regulators and industry experts wanted to ensure that the purchaser of these divisions was already active in the life science industry (manufacturing expertise, brands, patents, know-how, etc) given the difficulty of new entrants to compete in the market (European Commission, 2013). The terms of the settlement included complete transfer of all processing and distribution facilities, intellectual property (trademarks, patents, licenses, permits, authorizations) technology, equipment, contracts, leases and personnel of Dharmacon™, HyClone® and Sera-Mag™ (US Federal Trade Commission – *Decision and Order*, 2014).

## *III. Data*

The European Commission conducted a thorough market analysis of the life science industry to get a better picture of the effect the merger would have on the industry. Below is compiled pre-merger market share data across cell media/sera, siRNA and magnetic beads.

*Table 1 - Parties' and competitors' market shares in the supply of cell media to bioproduction customers at global level in 2012*

| **Product** | **Thermo Fisher** | **Life Technologies** | **Sigma Aldrich** | **BioRad** | **Lonza** | **Others** |
|---|---|---|---|---|---|---|
| Media (all) | [10-20]% | [30-40]% | [20-30]% | [10-20]% | [0-5]% | [0-5]% |
| Media in liquid form | [20-30]% | [40-50]% | [20-30]% | [0-5]% | [5-10]% | [10, 20]% |
| Media in dry form | [10-20]% | [30-40]% | [20-30]% | [10-20]% | [0-5]% | [0-5]% |
| Custom Media | [10-20]% | [30-40]% | [40-50]% | [0-5]% | [0-5]% | [5-10]% |
| Proprietary Media | [10-20]% | [40-50]% | [10-20]% | [20-30]% | [0-5]% | [0-5]% |
| Standard Basal Media | [0-5]% | [40-50]% | [10-20]% | [0-5]% | [30-40]% | [0-5]% |
| Chemically defined Media | [20-30]% | [60-70]% | [0-5]% | [0-5]% | [10-20]% | [0-5]% |
| Non-chemically defined media | [10-20]% | [30-40]% | [30-40]% | [10-20]% | [0-5]% | [0-5]% |
| Process liquids | [30-40]% | [10-20]% | [20-30]% | [0-5]% | [20-30]% | [10-20]% |

*Source: European Commission, 2013*

*Table 2 - Parties' and competitors' market shares in the supply of cell media to research customers at global level in 2012*

| Product | Thermo Fisher | Life Technologies | Sigma Aldrich | BioRad | Lonza | Others |
|---|---|---|---|---|---|---|
| Media (all) | [0-5]% | [60-70]% | [5-10]% | [0-5]% | [10-20]% | [5-10]% |
| Media in liquid form | [0-5]% | [60-70]% | [5-10]% | [0-5]% | [20-30]% | [5-10]% |
| Media in dry form | [0-5]% | [40-50]% | [10-20]% | [0-5]% | [0-5]% | [40-50]% |
| Custom Media | [0-5]% | [10-20]% | [20-30]% | [5-10]% | [10-20]% | [30-40]% |
| Proprietary Media | [0-5]% | [40-50]% | [10-20]% | [0-5]% | [30-40]% | [10-20]% |
| Standard Basal Media | [0-5]% | [60-70]% | [0-5]% | [0-5]% | [20-30]% | [5-10]% |
| Chemically defined Media | [0-5]% | [10-20]% | [0-5]% | [10-20]% | [70-80]% | [0-5]% |
| Non-chemically defined media | [0-5]% | [60-70]% | [5-10]% | [0-5]% | [10-20]% | [10-20]% |
| Process liquids | [0-5]% | [50-60]% | [30-40]% | [0-5]% | [0-5]% | [5-10]% |

*Source: European Commission, 2013*

*Table 3 - Parties' and competitors' market shares in the supply of fetal bovine sera (FBS) to bioproduction customers at global level in 2012*

| Region | Thermo Fisher | Life Technologies | Sigma Aldrich | GE | Merck Millipore | Other |
|---|---|---|---|---|---|---|
| Australia and New Zealand | [10-20]% | [20-30]% | [20-30]% | [5-10]% | [0-5]% | [20-30]% |
| Australia | [5-10]% | [10-20]% | [20-30]% | [5-10]% | [5-10]% | [30-40]% |
| New Zealand | [10-20]% | [30-40]% | [20-30]% | [5-10]% | [0-5]% | [20-30]% |
| US and Canada | [10-20]% | [0-5]% | [20-30]% | [5-10]% | [5-10]% | [40-50]% |
| US | [20-30]% | [0-5]% | [20-30]% | [5-10]% | [5-10]% | [40-50]% |
| Canada | [0-5]% | [0-5]% | [5-10]% | - | [0-5]% | [90-100]% |
| South America | [10-20]% | [0-5]% | [20-30]% | [5-10]% | [5-10]% | [40-50]% |

*Source: European Commission, 2013*

*Table 4 - Parties' market shares in the supply of fetal bovine sera (FBS) to research customers at global level in 2012*

| Region | Thermo Fisher | Life Technologies |
|---|---|---|
| US and Canada | [10-20]% | [20-30]% |
| US | [20-30]% | [0-5]% |
| Canadian | [0-5]% | [0-5]% |
| South America | [10-20]% | [0-5]% |

*Source: European Commission, 2013*

*Table 5 - Parties and competitors market shares in the supply of gene silencing reagents worldwide in 2012*

| Product | Thermo Fisher | Life Technologies | Qiagen | Sigma Aldrich | IDT | Other |
|---|---|---|---|---|---|---|
| siRNA | [40-50]% | [20-30]% | [10-20]% | [5-10]% | [0-5]% | [5-10]% |
| shRNA | [20-30]% | [0-5]% | [0-5]% | [50-60]% | [0-5]% | [5-10]% |
| miRNA | [20-30]% | [50-60]% | [10-20]% | [0-5]% | [0-5]% | [5-10]% |

*Source: European Commission, 2013*

*Table 6 - Parties and competitors market shares in the supply of polymer-based magnetic beads to OEM customers in 2012*

| Product | Thermo Fisher | Life Technologies | Agilent | Merck Millipore | Others |
|---|---|---|---|---|---|
| Polymer-based magnetic beads | [10-20]% | [50-60]% | [10-20]% | [10-20]% | [5-10]% |

*Source: European Commission, 2013*

## *IV. Model*

I will be setting up a simple Cournot model to predict the cost per firm in this market given the listed market shares in the data tables above. French mathematician Augustin Cournot introduced this economic model in 1838 to describe an industry where companies will compete on the amount of output they will produce independently of each other and at the same time. While the original model only dealt with a duopoly (two firms in the market), it can be extended to include multiple firms. The Cournot model makes the following assumptions (OECD, 2002):

(1) Firms produce homogenous goods (no product differentiation)
(2) Firms do not cooperate (no collusion)
(3) Firms have market power (output decision affects the price of the good)
(4) The number of firms are fixed
(5) Firms choose the quantity to produce simultaneously
(6) Firms seek to maximize profit given their competitor's decision

Using the Cournot model, I will develop a system of non-linear equations to determine the quantity produced for individual firms as a function of its cost. An individual firm's market share is determined by how much it costs them to product a certain good, so once determining the cost function I can predict what market shares should look like after Thermo Fisher and Life Tech merge. In this system of equations I assume there are three firms in the market – Thermo Fisher, Life Tech and Other (the aggregate of all competitors in the market). Because I know nothing about the nature of demand in this market, other than assuming it is downward sloping, I assume the elasticity of demand is 1 - meaning that the percentage change in quantity is equal to the percentage change in price. This system of non-linear equations does not appear to have a closed form solution, thus a MATLAB® program will be constructed to compute numeric values for our variables of interest.

The program will be divided into "Pre-Merger" and "Post-Merger" sections. The Pre-Merger code will compute the costs per firm that rationalize the given market shares and the

Post-Merger section will determine the quantity produced at that given cost as well as the new market share of the combined firms. The quantity produced tells us what consumer surplus looks like, if the quantity produced post-merger is lower than the quantity produced pre-merger then we can conclude the consumers are worse off as a result. I can also use this model to compute what the merged firm's cost *need to be* in order to make consumers no worse off or better. Below are the mathematical operations used to create the MATLAB® program to determine firm cost, quantity and market share. See Appendix 1 for MATLAB® code.

(1) Givens

3 firms in the market with costs $c_1$, $c_2$, $c_3$ and elasticity of demand (A) of 1

Demand curve: $P = a - bQ$

(2) Individual firm profit-maximization functions

$$\pi_1 = Pq_1 - c_1 q_1$$

$$\max_{q_1} \pi_1 = (q_1 + q_2 + q_3)^{(-A)} q_1 - c_1 q_1$$

$$\max_{q_2} \pi_2 = (q_1 + q_2 + q_3)^{(-A)} q_2 - c_2 q_2$$

$$\max_{q_3} \pi_3 = (q_1 + q_2 + q_3)^{(-A)} q_3 - c_3 q_3$$

(3) Solving for individual firm's quantity as a function of cost using first-order conditions

$$\frac{(\partial \pi_1)}{(\partial q_1)} = -1(q_1 + q_2 + q_3)^2 q_1 + (q_1 + q_2 + q_3)^{-1} - c_1 = 0$$

$$\frac{(\partial \pi_2)}{(\partial q_2)} = -1(q_1 + q_2 + q_3)^2 q_2 + (q_1 + q_2 + q_3)^{-1} - c_2 = 0$$

$$\frac{(\partial \pi_3)}{(\partial q_3)} = -1(q_1 + q_2 + q_3)^2 q_3 + (q_1 + q_2 + q_3)^{-1} - c_3 = 0$$

(4) Market share estimation

$$\frac{q_1}{(q_1 + q_2 + q_3)} = S_1 \qquad \frac{q_2}{(q_1 + q_2 + q_3)} = S_2 \qquad \frac{q_3}{(q_1 + q_2 + q_3)} = S_3$$

## V. *Results*

*Table 7 - Pre-Merger cost functions that rationalize market shares and output at that cost*

| | **Cell Media** (Bioproduction) | **Cell Media** (Research) | **Cell Culture Sera** (Bioproduction) | **Cell Culture Sera** (Research) | **siRNA** | **Polymer based Magnetic Beads** |
|---|---|---|---|---|---|---|
| **Thermo Fisher** | 15% | 2.5% | 15% | 15% | 45% | 15% |
| **Life Technologies** | 35% | 65% | 2.5% | 25% | 25% | 55% |
| **Other Firms** | 50% | 32.5% | 82.5% | 60% | 30% | 30% |
| **Thermo Fisher Cost** | 1.116 | 1.397 | 1.029 | 1.097 | 0.891 | 1.214 |
| **Life Tech Cost** | 1.001 | 1.171 | 1.115 | 1.037 | 1.016 | 1.025 |
| **Other Firm Cost** | .915 | 1.288 | 0.563 | 0.827 | 0.985 | 1.143 |
| **Total Output** | .832 | .712 | .883 | .843 | .854 | .779 |

Market share was determined by averaging the range of possible market share values from data tables in the "Data" Section. As is expected, the firms with the lower costs have the higher market share and vice versa.

*Table 8 - Post-Merger Quantity Output and Market Share with and without the settlement*

| | **No Settlement Market Share** | **Yes Settlement Market Share** | **No Settlement Quantity** | **Yes Settlement Quantity** | **No Settlement Cost** | **Yes Settlement Cost** |
|---|---|---|---|---|---|---|
| **Cell Media (Bioproduction)** | 42% | 42% | .814 | .814 | 1.001 | 1.001 |
| **Cell Media (Research)** | 66% | 66% | .710 | .710 | 1.171 | 1.171 |
| **Cell Culture Sera (Bioproduction)** | 16% | 7% | .879 | .862 | 1.029 | 1.115 |
| **Cell Culture Sera (Research)** | 31% | 31% | .824 | .824 | 1.037 | 1.037 |
| **siRNA** | 58% | 47% | .822 | .797 | .891 | 1.016 |
| **Polymer based Magnetic Beads** | 63% | 63% | .764 | .764 | 1.025 | 1.025 |

The merged firms cost without the settlement is determined by taking the lowest cost between Thermo Fisher and Life Tech. In this scenario, Thermo acquires Life Tech and has to give away nothing in return thus can use the lowest production input costs from both firms. The merged firm cost with the settlement was determined by replacing all of Thermo Fisher's costs with those of Life Tech's. As a condition of the merger, Thermo Fisher was required to sell off all of its production technology, know-how and personnel from its cell media/sera, siRNA and magnetic beads businesses. Thus the merged firm's production inputs for these products derive only from Life Tech's brands and their cost of production. Life Tech already had the lowest costs for most product areas, but will have its higher costs for cell culture sera for bioproduction customers and siRNA replace Thermo Fisher's.

*Table 9 – Pre and Post Merger comparison with Cost Synergies to Consumer Surplus*
***split cells are Thermo Fisher on top and Life Tech on bottom*

| | Pre-Merger Market Share | Post-Merger Market Share | Pre-Merger Quantity | Post-Merger Quantity | Pre-Merger Costs | Post-Merger Cost | Cost Synergy to Improve Consumer Surplus |
|---|---|---|---|---|---|---|---|
| **Cell Media (Bioproduction)** | **15%** | **42%** | **.832** | **.814** | **1.116** | **1.001** | **>.915** |
| | **35%** | | | | **1.001** | | |
| **Cell Media (Research)** | **2.5%** | **66%** | **.712** | **.710** | **1.397** | **1.171** | **>1.160** |
| | **65%** | | | | **1.171** | | |
| **Cell Culture Sera (Bioproduction)** | **15%** | **7%** | **.883** | **.862** | **1.029** | **1.115** | **>1.013** |
| | **2.5%** | | | | **1.115** | | |
| **Cell Culture Sera (Research)** | **15%** | **31%** | **.843** | **.824** | **1.097** | **1.037** | **>.946** |
| | **25%** | | | | **1.037** | | |
| **siRNA** | **45%** | **47%** | **.854** | **.797** | **.891** | **1.016** | **>.734** |
| | **25%** | | | | **1.016** | | |
| **Polymer-based Magnetic Beads** | **15%** | **63%** | **.779** | **.764** | **1.214** | **1.025** | **>.951** |
| | **55%** | | | | **1.025** | | |

## *VI. Analysis and Conclusion*

According to this model, the merger between Thermo Fisher Scientific Inc. and Life Technologies™ certainly leaves consumers worse off than they were before the merger. There was no instance in which consumer surplus increased or even remained the same. Output of cell media to bioproduction customers decreased by 2.19% and to research customers by .281%. Output of cell culture sera to bioproduction customers decreased by 2.41% and to research customers by 2.28%. Lastly output of siRNA reagents decreased by 6.9% and output of polymer-based magnetic beads decreased by 1.94%. While the scale of these decreases may seem small, the volume at which these products are ordered across every laboratory globally makes even fractions of percentages of changes in output (and price as a result) result in millions of dollars of difference. This finding is not surprising however, decrease in output and increase in price is typically observed as a result of mergers and acquisitions (Werden et al 2006). While there is indication that output has decreased, the real effect on price goes beyond the jurisdiction of this research. Due to non-disclosure agreements that the University of Georgia has with its vendors, I legally cannot disclose price information for certain products before and after the merger.

In this model, the settlement proposal did little to prevent Thermo Fisher from acquiring close to/more than a majority market share in any of the product areas and actually resulted in a lower level of output than there otherwise would be. The only two areas it affected were Thermo Fisher's cell culture sera sales to bioproduction customers and siRNA reagents. Life Technologies had a lower production cost for every other product area so Thermo Fisher would have used their production technology regardless of the settlement, but in those two areas it had to use Life Tech's more costly technology. Had there been no settlement that forced Thermo to use higher cost inputs there would have only been a .45% decrease in output in cell sera to bioproduction customers as opposed to 2.19% and a 3.82% decrease in siRNA reagents as opposed to 6.9%. However, it is difficult to say that the settlement was *worse* for consumers, or even the merger itself, based on this data alone. There are a range of assumptions I have made about the model that may not play out in reality.

First, Life Tech and Thermo Fisher are not necessarily producing homogenous goods. While the two certainly have overlap in the products that they produce, they may have different variations that appeal to certain scientific needs. It may not be easy enough to just switch out a Thermo Fisher product for a Life Tech product due to differences in concentration, volume, potency etc. If the goods are not homogenous then the model can no longer accurately predict the cost functions for individual firms. Second, I have assumed that the elasticity of demand is 1. Since I know nothing about demand in this market I assumed that the percentage change in quantity is *exactly* equal to the percentage change in price which is most likely not true. If there is a change in the demand elasticity, then the first order conditions for cost and quantity will change substantially giving different values for both of these variables thus changing the conclusions of the data. Third, I don't know if the change in output has resulted in a change in price. It's difficult to say the settlement was unsuccessful based on a decrease in output alone if it did not translate into higher prices. Had there been no settlement it's possible that Thermo Fisher would have charged exorbitant prices for several products that there were virtually no other competitors for. However, it's also possible that Thermo Fisher is still charging higher prices, but the emergence of GE Healthcare may be providing a lower cost alternative.

Based on this research, the merger between Thermo Fisher and Life Tech will not help the average consumer. Given the predicted decrease in output, research scientists should anticipate an increase in price, if it has not already happened, for several products from Thermo

Fisher. While many researchers are prone to succumb to brand loyalty, this bad news for an industry already facing funding crunches. As the biotechnology market works to adjust to this merger between two of its giants, individuals in the scientific research and bioproduction community should continue to seek out lower cost alternatives and diversify their options.

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# VIII. *Appendix I*

## Pre-Merger

I. Costs

```
% initial guess of costs
% global c0;
c0 = [0;0;0];

% solves for costs that rationalize market shares
options =
optimoptions('fsolve','Display','iter','MaxIter',1e8,
'MaxFunEvals',1e8);

[copt,fval] = fsolve(@shares,c0,options);
disp(exp(copt))
```

II. Market Shares

```
function F = shares(c)

   sdat = [Market Share 1; Market Share 2;
Market Share 3];

   % defines an anonymous function
   f = @(q)tmpfun(q,c);

   % solve for quantity given costs
   q0 = ones(3,1);
   options =
optimoptions('fsolve','Display','iter','MaxIter',1e8,
'MaxFunEvals',1e8);
   [qopt,~] = fsolve(f,q0,options);

   % computes shares from qopt
   smod = zeros(3,1);
   smod(1) = qopt(1)/sum(qopt);
   smod(2) = qopt(2)/sum(qopt);
   smod(3) = qopt(3)/sum(qopt);

   % computes objective function
   F = smod-sdat;

   disp(['total quantity = ' num2str(sum(qopt))]);
 end
```

III. Quantity

```
function G = tmpfun(q,c)

   % First-order condition for firms
   G = zeros(3,1);
   G(1) = -q(1)/(sum(q)^-2) + sum(q)^-1 - exp(c(1));
G(2) = -q(2)/(sum(q)^-2) + sum(q)^-1 - exp(c(2));
   G(3) = -q(3)/(sum(q)^-2) + sum(q)^-1 - exp(c(3));

   %disp(q)
   %disp(c)
 end
```

## Post-Merger

I. Costs

```
% ENTRY IN COSTS
c0 = [Cost of Merged Firm; Cost of Other Firms];

shares(c0);
disp( c0 );
```

II. Market Shares

```
function shares(c)

   % defines an anonymous function
   f = @(q)tmpfun(q,c);

   % solve for quantity given costs
   q0 = ones(2,1);
   options =
optimoptions('fsolve','Display','iter','MaxIter',1e8,
'MaxFunEvals',1e8);
   [qopt,~] = fsolve(f,q0,options);

   disp(['total quantity = ' num2str(sum(qopt))]);

   s1 = qopt(1)/sum(qopt);
   s2 = qopt(2)/sum(qopt);
   disp(['share 1 = ' num2str(sum(s1))]);
   disp(['share 2 = ' num2str(sum(s2))]);
 end
```

III. Quantity

```
function G = tmpfun(q,c)

   % writes down first-order condition for firms
   G = zeros(2,1);
   G(1) = -q(1)/(sum(q)^-2) + sum(q)^-1 -
log(exp(c(1)));
   G(2) = -q(2)/(sum(q)^-2) + sum(q)^-1 -
log(exp(c(2)));

   %disp(q)
   %disp(c)
   end
```