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Lopsided Schumpeterian Competition and the Superstar Firm Phenomenon



COLLABORATIVE EFFORT BY MARK LEHRER, I-KIM WANG, AND MICHAEL BEHNAM

In many industries worldwide, gains from technological innovation have increasingly accrued only to the largest and most resource-endowed companies, while most companies lag in implementation of vital new technologies. As a result, the phenomenon of so-called “superstar” firms that outdistance industry rivals has become a major topic in technology management.

By applying the concept of “superstar” firms to the study of competition in the organic light-emitting diode (OLED) industry in the 21st century, we show why Samsung completely dominated the OLED smartphone screen industry, while LG, which had a monopoly on OLED television screens, exerted a smaller degree of industry dominance.

OLED IS A ‘FICKLE’ TECHNOLOGY

In the early 2000s, the flat-panel industry believed that OLED displays would replace liquid crystal display (LCD) displays in various sizes, including televisions, which were the most profitable display products. OLED displays were attractive due to their slim design, energy efficiency, and superior image quality in comparison to LCD screens.

Flat-panel makers discovered that their expertise in producing LCD panels did not equip them for the challenges of manufacturing OLED displays, despite predictions that OLED would replace LCD. To produce OLED displays, panel makers had to assemble more than 100

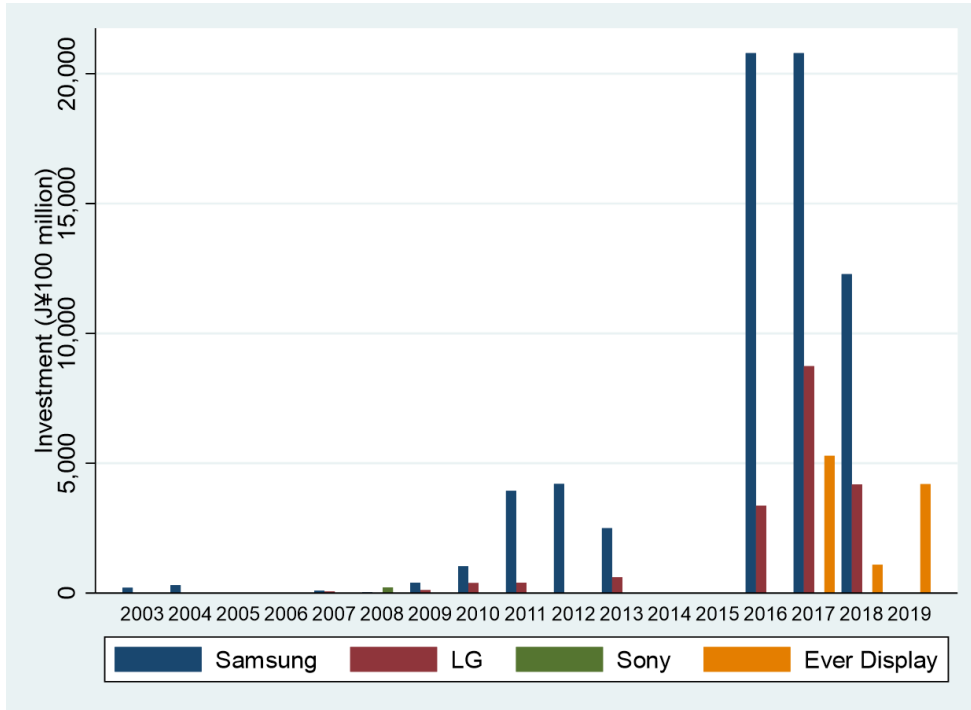


Figure 1: Major AMOLED Investments 2003-19

layers of materials, which required precise engineering and had little tolerance for impurities in any layer. According to interviews, OLED became known as a "fickle" technology because companies struggled to increase yields and improve production efficiency.

New players in the active matrix (AMOLED) segment were rare as most established LCD firms that attempted to explore AMOLED production encountered technical difficulties, low yields, and market uncertainty about the advantages of AMOLED screens. Sony's experience exemplifies the challenges of mastering OLED production. Sony was one of the

earliest to present a full-color 13-inch AMOLED prototype in 2001, while most panel makers were still in the early stages of OLED R&D. Sony aimed to produce large OLED displays for televisions, launching OLED production lines in 2004 and introducing the world's first commercial OLED TV in 2007. However, poor sales led Sony to revise its OLED strategy to focus on smaller displays.

UNEXPECTED RISE

When efforts resulted in no clear breakthroughs, Sony and other Japanese firms came to a screeching halt in AMOLED production. For a while, the OLED market lacked an active player. This created a window of opportunity for Samsung and LG.

It turned out that only the most well-endowed and persistent panel makers were able to master the fickle technology. Both Samsung and LG emerged as quasi-monopolists in the AMOLED segments they targeted (smartphones and TV sets) after two decades of unrelenting investment. Figure 1 shows that Samsung and LG were the main firms that invested in OLED until 2017, when the Chinese firm Ever Display also endeavored to enter the OLED space.

Samsung and LG leveraged their significant investments in building a network of dedicated suppliers through joint ventures and vertical integration. The main supplier relationships are shown in Figure 2.

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Samsung has established partnerships with various companies to produce materials and components for OLED displays. One of these partnerships is with Corning, and together they created Samsung Corning Advanced Glass, which has been producing glass substrates for OLED displays since 2012. Another joint venture is with Ube Industries since 2011, and it focuses on developing substrate materials. In 2013, Samsung acquired Novald, which is a leading provider of proprietary organic materials based in Dresden, Germany. Additionally, Samsung formed SFC with Hodogaya Chemical in 2011, and they established an R&D center for OLED materials. Although there are other suppliers like Kateeva and Kyulux that work with other makers,

Samsung and LG leveraged their significant investments in building a network of dedicated suppliers through joint ventures and vertical integration.

Samsung has direct investment and equity ownership in both of these suppliers.

LG has the advantage of being able to rely on chemical expertise from its own division, LG Chem, and from its acquisition of Kodak, which is the photochemical company that originally invented OLED.

Even though LG also uses some external suppliers, such as UDC and Kyulux, which also work with Samsung, LG's supplier network is more vertically integrated compared to Samsung's. Like Samsung, LG exercises a level of control over its suppliers in cases where LG use some of the same licenses and expertise as other firms.

Our interpretation is that Samsung and LG adapted to a technological regime that was much more of a 'supplier-dominating' type of regime than a supplier-dependent one. Superstar firms continue their dominance over the AMOLED market because their competitors could not find Tier 1 suppliers that are not on the Samsung or LG supplier network. Chinese firms BOE Hydis and Ever Display had no means to improve production yields.

The window of opportunities closed as the supplier-dominating regime characterizes the OLED competition. Sony and three other Japanese companies (Panasonic, Toshiba, and Hitachi) formed a joint venture called JOLED in 2015 to combine their OLED resources.

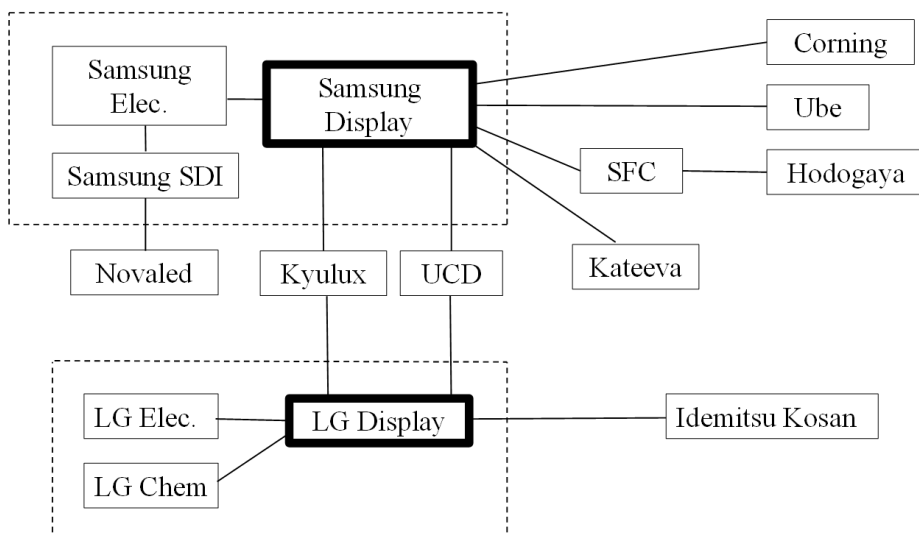


Figure 2: OLED Supplier Network of Samsung, LG

Superstar firms continue their dominance over the AMOLED market because their competitors could not find Tier 1 suppliers that are not on the Samsung or LG supplier network.

However, by this time, Samsung had already established a monopoly on smartphone OLED displays. While even the combined efforts of Panasonic, Toshiba and Hitachi did not lead to any large-scale OLED production, it was LG that ended up making virtually all of the OLED TV screens, even those in the products of other TV manufacturers.

As the AMOLED market wraps up its first decade of commercialization, there are only a handful of active firms, with one single firm - Samsung - holding a 90%-95% market share for much of the 2010s, dominating the mega-market of smartphone screens. Even archrival Apple was dependent on Samsung for its OLED screens, as shown in Figure 3.

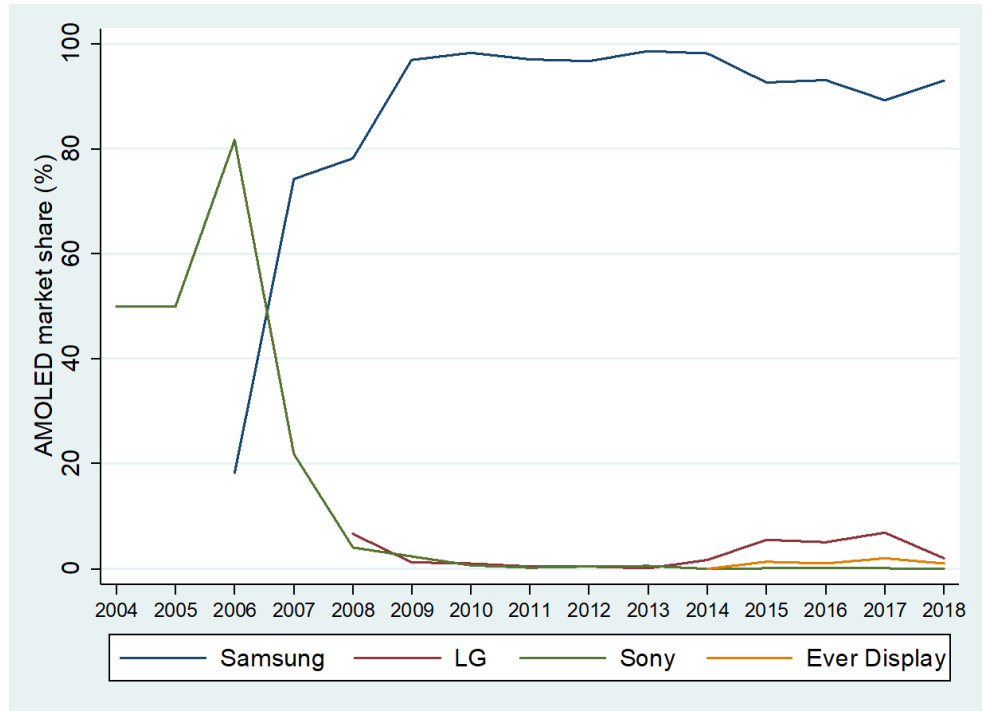


Figure 3: Leading Firms' Market Share in AMOLED

SUPERSTARS OR SHOOTING STARS?

It can be assumed that Samsung's dominance will slowly erode. The point is worth mentioning because evidently there are national dimensions to the OLED industry. It is hard to overlook the fact that Samsung and LG are both South Korean firms or to consider this fact coincidental. Massive investments by state-backed Chinese entrants have opened a new phase in the OLED industry especially after 2014. The national system of innovation is surely relevant to the patterns of competition in the OLED industry and may predict whether superstar

firms can hold on their monopoly positions.

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