
RE: Response to Request for Public Comments on Risks in the Information and Communications Technology Supply Chain

FROM: The Open Markets Institute, Washington

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Introduction:

The Open Markets Institute has prepared this comment in response to a request by the Department of Commerce on September 20, 2021 to assist the Secretary of Commerce and the Secretary of Homeland Security in preparing a report required by Executive Order 14017 on “America’s Supply Chains.” The report is based on the Biden administration’s intentions to strengthen America’s supply chains, including for Information and Communications Technology (ICT) hardware. The Open Markets Institute is well-known as a pioneer in the study of modern supply chains and has long warned of fundamental flaws in how they are structured and run.

Background:

In recent years, the world has been made aware of a wide variety of problems within the supply chains of many of the industrial systems on which we rely. These problems include the inability to produce sufficient quantities of personal protective equipment such as N-95 masks and testing materials in the early days of the Covid-19 pandemic, chronic shortfalls in production of semiconductors and resulting worldwide shutdowns of assembly lines for automobiles and electronics, massive disruptions to intermodal cargo transportation systems, and the exploitation of supply dependencies by nation states to politically coerce individual corporations and other nation states. These problems derive from many sources, but two especially stand out: extreme geographic concentration of certain industrial production within single nations, and extreme concentrations of corporate ownership and control over particular industrial activities.

Geographic Concentration:

A generation ago, the manufacturing of ICT hardware was widely dispersed across North America, Europe, and East and Southeast Asia. Today, by contrast, the manufacturing of many components and the assembly of finished products tends to be concentrated in a few — and sometimes only one — location.

The leading countries for manufacturing of ICT goods are (in order): China, Singapore, Japan, Taiwan, Malaysia, and South Korea.[1]
China, for instance, accounts for:

- 57 percent of global mobile phone exports (2018) [2]
- 49 percent of global computer exports and tablets (2018)[3]
- 43 percent of global household electrical goods (2018)[4]
- 26.5 percent of global hard disk drive exports (2019)[5]

South Korea accounts for:

- 97 percent (2016) of the global organic light-emitting diode (OLED) market based on value [6]
- 37 percent (2016) of the global liquid crystal display (LCD) market based on value [7]
- 46 percent (2020) of the production of memory chips [8]

Taiwan accounts for:

- 98 percent (2013) of global production of motherboards[9]
- 93 percent (2013) of global production for notebook PCs[10]
- 90 percent of the global computer server market [11]
- 43 percent of the manufacturing capacity for logic-based semiconductor chips[12]

Japan accounts for:

- 32 percent (2020) of global production of optoelectronics [13]

Additionally, Southeast Asia accounts for:

- 69 percent of assembly operations for electronics hardware [14]

**Corporate Concentration:**

A small number of corporations have monopolized key areas of the ICT industry, such as telecommunications equipment, semiconductors, and computer hardware.

- Corning has captured 73 percent of the smartphone display market, and 40 percent of the entire display glass market.[15]
- In the market for hard disk drives, three companies, Western Digital, Seagate, and Toshiba, make up 100 percent (2020) of the market.[16]
  - One of the key components in hard disk drives is the spindle motor. One company, Nidec Corporation, controls 80 percent of the market.[17]
- TSMC, located in Taiwan, manufactures most of the logic chips needed for computers and electronics with a 54 percent global market share in foundry capacity [18]
- The company currently has a 90 percent market share in these advanced chips,[19]
- 72.7% of the global dynamic random-access memory (DRAM) market is held by two South Korean companies, Samsung and SK Hynix, with 43.5 percent and 29.2 percent respectively. [20]
- Together, Japanese companies Shin Etsu and Sumco, have a 60 percent market share in the production of silicon wafers. [21]
- Huawei, Ericsson, Nokia, Samsung, and ZTE have over 90 percent of the market (2020) in mobile base stations, the key component of cellular networks. Huawei has a 29 percent market share, Ericsson has 26 percent, Nokia has 21.5 percent, Samsung has 9 percent, and ZTE has 4.5 percent.[22]
- Skyworks, Murata, Qualcomm, Qorvo, and Broadcom control 85% of the RF front-end market, the circuitry responsible for receiving signals, with Skyworks leading the market.[23]
- Cisco has captured 44 percent (2021)[24] of the ethernet switch market and 34 percent (2021) of the combined service provider and enterprise router market.[25]
- In the market for solid state drives, Samsung controls 28 percent of the market, Western Digital controls 20 percent, Kingston controls 12 percent, Kioxia controls 10 percent, and Intel controls 8 percent.[26]

**Analysis:**

In the mid-1990s, both the ownership and production of ICT hardware were widely dispersed and highly competitive. U.S. corporations remained world leaders in both design and production of most ICT goods. Since then, however, four main factors have played large roles in the radical restructuring of who makes these products and where they are made. These factors are:

- **Changes in How the United States Regulates Competition**, most importantly the radical relaxation of anti-merger regulation in the 1980s and 1990s. This resulted in rapid and in some cases extreme consolidation among U.S.-based manufacturers. Later, as other nations embraced U.S. competition philosophy, it resulted in rapid and in some cases extreme consolidation among European and Asian manufacturers.

- **Changes in How the United States Regulates Trade**, most importantly the radical relaxation of America’s long-standing opposition to nation-state supported monopolization of manufacturing capacities (mercantilism). This resulted in a rapid and in some cases extreme consolidation of power over particular links within supply chains by Taiwan, Japan, South Korea, Germany, and especially China.

- **Changes in U.S. Corporate Governance Rules and Practices**, most importantly the radical shift of power away from professional management and engineering teams into the hands of powerful financial actors and other absentee “owners.” This resulted in a rapid and in some cases extreme liquidation of industrial capacities and skills situated
under the control of U.S. corporations, sometimes to a point of complete destruction of domestic industrial know-how.

- **The Introduction of Internet-Based Communications Technologies**, which made it easier to link production capacities and teams in different locations within a nation, and increasingly in different locations within the world, into a single integrated system of production.

*Other Effects of Concentration:*

In addition to the dangers listed above, this radical concentration of capacity and ownership has resulted in a variety of other harmful political and economic effects. These include:

- **Slower innovation**, as powerful monopolists choose not to invest in new technologies while retaining the power to prevent new rivals from emerging, and sometimes exercising power in ways that make it hard for their suppliers to invest in new technologies.
- **Higher prices**, due both to exercises of raw power by monopolistic suppliers and to the effects of shortfalls in production of goods such as cars and finished electronics due to the lack of inputs produced by such suppliers.
- **The suppression of growth and innovation in emerging markets** in Central and Eastern Europe, India, Brazil, Mexico, South Africa, and Southeast Asia due to the concentration of high-end production capacity in China.
- **Breaches in communications security** as China-based manufacturers of ICT — such as Huawei — have come to dominate the production of key internet hardware.

*Recommendations:*

The Biden administration should take the following actions to address the geographic concentration of production and the concentration of private control over key portions of the ICT supply chain:

1. **Use trade law, export controls, and other related tools** to encourage diversification in global production of ICT hardware. As Open Markets details in this article in *Foreign Affairs*, the United States can do this unilaterally, or in coordination with it’s G-7 and other close allies. (The executive summary of the Biden administration’s 100-day report on global supply chains correctly identifies the necessity for supply chains to be globalized if they are to be resilient.)

2. **Expand antitrust policies** to take account of geographic and ownership consolidation within supply chains. Such policies should recognize the effects of monopsonistic control over suppliers, not only those located in the United States but those located abroad that help to supply U.S. demand.
3. **Require corporations that import ICT hardware into the United States to diversify their contract manufacturing** in ways that force contract manufacturers to distribute their manufacturing capacity more widely. The goal should be to ensure that no one nation controls more than 25 percent of ICT products being produced for import to the U.S.

4. **Require both U.S. firms and their contract manufacturers to stress-test and map** networks of suppliers, manufacturers, distributors, and other elements of logistics networks to identify bottlenecks in the ICT supply chain.

*Additional Reading:*

- “Built to Break: The International System of Bottlenecks in the Era of Monopoly,” Barry Lynn, *Challenge Magazine*, March/April 2011. In this article, we update the basic thesis from *End of the Line* to account for lessons from the Lehman crash of 2008 and the Tohoku disaster of March 2011. This is the most concise, comprehensive explanation of the nature and origins of the problem.
- “How the United States marched the semiconductor industry into its trade war with China,” Chad P. Bown, Peterson Institute for International Economics, December 2020. Paper describes the economic and geographic transformation of the semiconductor industry and efforts by U.S. policymakers to weaponize trade policy targeting the industry’s supply chain.
- “Systemic Supply Chain Risk,” Yossi Sheffi and Barry C. Lynn, *The Bridge*, Fall 2014. The first article in which an engineer recognized the systemic nature of international production arrangements and the potential for cascading crashes.
Endnotes

[7] Frederick and Lee, Korea
[10] Evermann, ICT
[12] Khan, Mann, and Peterson, Semiconductors
[13] Khan, Mann, and Peterson, Semiconductors
[18] Khan, Mann, and Peterson, Semiconductors
[21] Khan, Mann, and Peterson, Semiconductors
[26] https://www.t4.ai/industry/ssd-market-share