Global Value Chains: Explaining U.S. Bilateral Trade Deficits in Semiconductors

John VerWey, Office of Industries
John.VerWey@usitc.gov, (202) 205-2022

The United States' semiconductor industry accounts for nearly 50% of global market share, in terms of sales, and semiconductors are the country's fourth largest export category, by value. Yet, despite the U.S. industry's global leadership, the United States has maintained growing bilateral trade deficits with countries (e.g. Indonesia, Malaysia, Thailand, and Vietnam) that have no domestic semiconductor industry, especially during 2015–17. This apparent discrepancy reflects the tendency of U.S. firms to increasingly contract out low-value-added elements of the supply chain (e.g. final assembly, testing, and packaging) to these Southeast Asian countries in particular. The trade balance with these countries would be much less negative, or perhaps even a surplus, if measured in value-added terms.

The Semiconductor Global Value Chain (GVC) Grows

The production of semiconductors (also referred to as "chips") occurs in three distinct stages: design, manufacturing, and assembly, test, & packaging (ATP). Major semiconductor companies, such as Intel (U.S.) and Samsung (South Korea), operate as integrated device manufacturers (IDMs), performing these steps in-house. However, in response to rising semiconductor production costs, niche companies that specialize in one or more step of the supply chain have emerged (Figure 1). "Fabless" companies, which engage solely in the design of semiconductors, partner with foundries (dedicated semiconductor manufacturers with no design capabilities) to fabricate devices before they are sent to ATP firms.[1] The Semiconductor Industry Association (SIA) estimates that 90 percent of the value of a chip is split evenly between design and manufacturing, with the final 10 percent of value added by ATP firms.

Figure 1: Operating Models in the Semiconductor Industry, and leading firms

Fabless-Foundry Model		
Design (Fabless) AMD, Broadcom, MediaTek, Spreadtrum, Qualcomm	**Manufacturing (Foundries)** Global Foundries, HH Grace, SMIC, Tower Jazz, TSMC, UMC	**Assembly, Test and Packaging (ATP)** Amkor, ASE, ChipPAC, JCET, J-Devices, Power-tech, SPIL
IDM Model		
Integrated Device Manufacturer (IDM) Infineon, Intel, Micron, Renesas, Samsung, Texas Instruments		

Source: Adapted from SIA and Nathan's Associates, "Beyond Borders: The Global Semiconductor Value Chain," 2016.

A Global Supply Chain

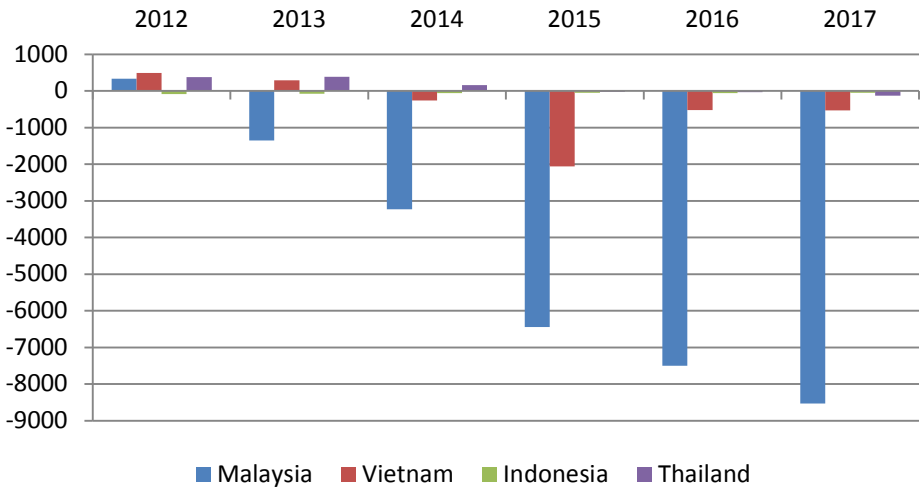
As the semiconductor GVC has lengthened, the geographic distribution of suppliers has expanded. Motivated by lower costs and proximity to consumers, nearly all U.S. IDMs, fabless companies, and foundries operate, or contract with, international entities that specialize in one or more step in the production process. While U.S.-headquartered companies account for nearly half of global market share in terms of global semiconductor sales, and the United States is home to nearly two-thirds of the global "fabless" market, there is a notable concentration of firms (many of which are operated by U.S. parent companies) providing ATP services in Malaysia, Indonesia, Thailand and Vietnam. When evaluating the competitiveness of the U.S. semiconductor industry using trade statistics, it is important to consider two implications of this global supply chain.

[1] The ATP stage of manufacturing may be outsourced to a different firm, or completed by the same firm.

1. U.S. Semiconductor Imports: Overstating Value Contributed by Southeast Asia

Though ATP providers only account for 10% of a chip's value, because they are the final step in semiconductor production, the export of the finished good registers the full value of the good against the balance of trade with a given country, even in countries where the design and/or manufacture of that chip (and thus 45-90% of its value) may have originated. Because of the high concentration of ATP facilities in Southeast Asia, U.S. trade data reports a significant bilateral trade deficit with select countries (Figure 2). If more-granular trade data were available on a strictly value-added basis for this category of goods,[2] the U.S. would most likely record a significant trade surplus.

Figure 2: U.S. Balance of Trade in Semiconductors with Select Southeast Asian Countries (million $)



Source: USITC DataWeb/USDOC (HTS subheading 8542; accessed February 7, 2018)

Additionally, U.S. imports of semiconductors are comprised of products that already contain significant U.S. value. U.S. semiconductor firms often import their own products after the ATP process for warehousing or sales purposes. U.S. manufacturers of products that incorporate semiconductors (such as computers or automobiles) also import a significant portion of products, which include U.S. added value, directly from overseas.

2. U.S. Semiconductor Exports and Fabless Design Work

The U.S. accounts for the majority of worldwide fabless design work and semiconductor design constitutes approximately 45% of a chip's final value. After designing a chip, U.S. fabless firms often contract with U.S.-based or overseas providers of manufacturing and ATP services to fabricate their devices.

However, the value of this design work is not recorded in U.S. goods trade data, though it may be at least partially captured in services export data. Thus current goods trade statistics may not fully capture the value of U.S. semiconductor industry exports.

Sources: CRS, "U.S. Semiconductor Manufacturing: Industry Trends, Global Competition, Federal Policy," 2016; USITC, "The Economic Effect of Significant U.S. Import Restraints," 2017; SIA "Comments to Commerce and USTR on Significant Trade Deficits," May 2017; SIA and Nathan Associates, "Beyond Borders: The Global Semiconductor Value Chain," 2016.

[2] Some efforts made by the OECD to capture this data are detailed at: oe.cd/tiva. Semiconductors fall under the "Computer, electronic and optical equipment" industry in the OECD's Trade in Value Added database, however this category also includes goods such as radio, television and communication equipment, medical, precision and optical instruments & watches and clocks.