

What’s Causing U.S. Semiconductor Equipment Production and Exports to Grow?

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The semiconductor¹ manufacturing equipment (SME) industry in the United States accounts for nearly 50 percent of worldwide production. The United States is also a leading SME exporter, with other major firms headquartered in Japan and the Netherlands. The SME industry has enjoyed record growth in recent years driven by demand from East Asian chip manufacturers, especially in the memory sector. Growth in exports has been bolstered by a growing sub-market for used SME, which can be refurbished and sold for use in older semiconductor fabrication processes. Increasing sales of used SME have resulted in U.S. domestic exports of SME exceeding U.S. production, which is explained below.

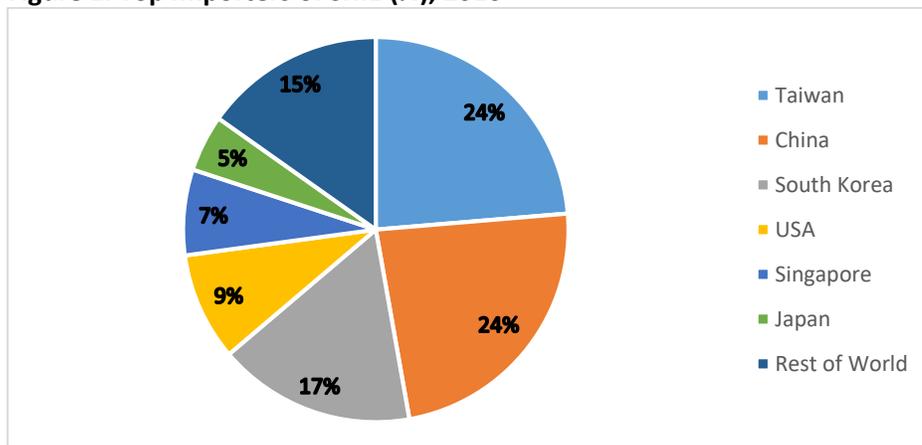
What is SME?

Semiconductor manufacturing equipment (SME) refers to a broad group of products used in the fabrication of semiconductor devices. The SME industry is broken down into two categories: front-end and back-end equipment. Front-end semiconductor manufacturing equipment refers to the products that create fully functioning chips on silicon wafers. Examples of these products include polishing and grinding equipment, lithography systems, chemical vapor deposition equipment and metrology systems. Back-end semiconductor manufacturing equipment refers to products that assemble, package, and test the functionality of these chips before they are incorporated into final goods. These products can include probes, voltage testers, machine vision systems, and oscilloscopes. The most advanced pieces of semiconductor manufacturing equipment today, such as extreme ultraviolet lithography tools that are used to produce the most powerful chips, can fetch prices as high as \$120 million per unit.

Evolution of the SME Industry and its Current State

The \$37 billion SME industry is highly concentrated, with firms headquartered in the United States (47 percent), Japan (30 percent) and the Netherlands (17 percent) maintaining over 90 percent of global market share in 2016 (the most recent year for which data are available). In 2016 the largest importers of SME were Taiwan, China, South Korea, the United States, and Singapore, which together accounted for 85% of SME imports in 2016 (Figure 1). These countries were also the largest exporters of chips.²

Figure 1. Top Importers of SME (%), 2016



Demand for SME stems from demand for semiconductors, which in turn is driven by demand for finished goods that incorporate chips such as smartphones, computers, and an increasing variety of consumer and industrial goods.

Source: HTS 8486, Global Trade Atlas, accessed November 7, 2018

¹ “Semiconductor,” “integrated circuit” and “chip” are used interchangeably in this EBOT.

² Hong Kong, which does not have large chip production capacity, recorded the most exports, due to re-exports.

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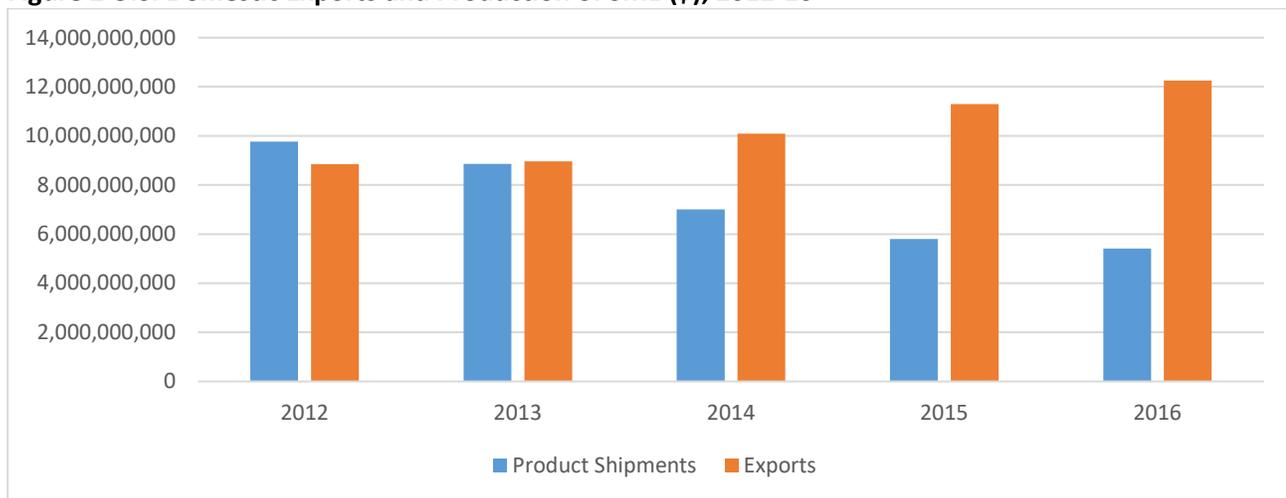
Recent Trends

The economic slowdown associated with the Great Recession (2007-09) reduced demand for semiconductors at a time when the SME industry was transitioning from 200mm (8-inch) to 300mm (12-inch) wafer processes. This transition to a larger wafer size was prompted by a desire among chipmakers to increase the number of chips that could be produced on a given wafer, thus achieving greater economies of scale. The drop in demand for chips resulted in a glut in the market for secondary equipment (SME that has been used, refurbished and/or remanufactured) as 200mm fabs³ closed and 300mm fabs opened. Post-recession, as both legacy 200mm and advanced 300mm semiconductor fabrication facilities have ramped up capacity there has been a corresponding increase in demand for new and used SME.

Used SME and Trade Statistics

The growth of the used SME market and sale of this used equipment has resulted in domestic exports of semiconductor manufacturing equipment, which do not distinguish between new and used equipment, exceeding reported total domestic production (Figure 2).

Figure 2 U.S. Domestic Exports and Production of SME (\$), 2012-16



Source: U.S. Census Department

This is likely because U.S. SME original equipment manufacturer (OEM) firms are purchasing used SME and re-selling that equipment at a higher price following value-added refurbishing. Large SME OEMs and large semiconductor fabrication firms currently operate used equipment business lines. As is the case with new SME, most used SME is sold abroad, likely to semiconductor firms in East Asia, where demand for 200mm and 300mm fabrication processes equipment continues to grow. The Census Department's Annual Capital Expenditures Survey, which reports CapEx for structures and equipment indicates that the U.S. semiconductor industry spent \$181 million on average on used equipment between 2012—16.

Sources: SEMI, [New Dynamics Changing the Secondary Equipment Market](#); SEMI, [Secondary Market Exploding With 200 mm Equipment](#); SEMI, [Secondary Equipment Market Readies for New Era](#); Shafer, [≤200mm semiconductor manufacturing is here to stay](#); Castellano, [Sizeable Changes In Semiconductor Equipment Market Share In 2017](#); Global Trade Atlas; Department of Commerce, [Top Markets Report](#); US Census Department, [Annual Capital Expenditures Survey](#); EE Times, [EUV Tool Costs Hit \\$120 Million](#)

³ A "fab" is the industry term for a semiconductor fabrication facility.