Semiconductors - Powering the Future

Edwin Davison, PhD, CFA, Associate Portfolio Manager and Senior Equity Analyst

Last month, we wrote about how many exciting new trends are investable through an analysis of the supply chains driving the growth. This month, we take a closer look at two long-term growth areas we previously identified, autonomous vehicles and Artificial Intelligence, and discuss the critical role that semiconductors are playing as these nascent industries continue to develop.

December 23, 1947, is a date in history that holds little significance for most people, but was, in many ways, the beginning of a new era. On that day, three scientists at Bell Labs invented the first working transistor using wafers of metallic Germanium and pure gold connectors. The new technology replaced vacuum tubes, which had been the basis of most electronic circuits up until that point. Vacuum tubes were used for amplification and switching of electrical signals, but were fragile, hot, and slow to warm up. Above all else, they were bulky. Iconic images of the 1930s or 1940s family often show them gathered around a radio the size of a chest of drawers with room on top for photos and plants. By 1955 however, transistor technology allowed you to "hold the world of radio in your hand"[1] with the development of the first commercially produced pocket radio.

Content Growth

Transistors remain a critical component of circuits. The ability to integrate more and more electronic components onto semiconductor wafers has allowed engineers to build faster, cheaper, and smaller systems. The first computer, designed in 1946 using old vacuum tube technology, weighed 30 tons and filled a 1700 square foot room. When Apple introduced the first personal computer in 1977 using semiconductors, it measured the size of a small box.

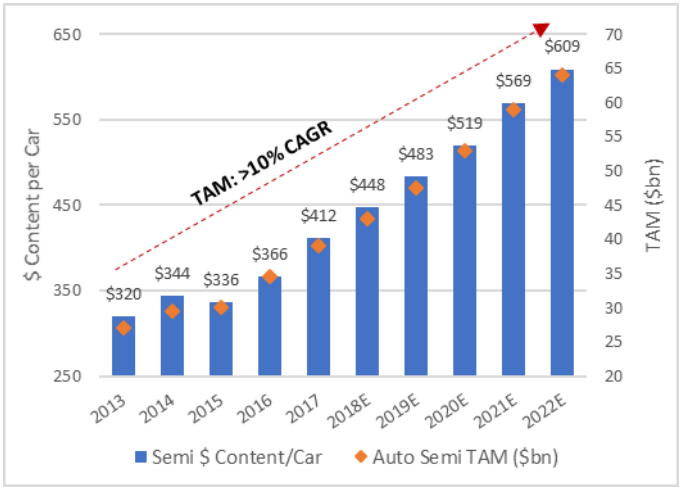
Growth in semiconductors has primarily been driven by computers, tablets, and smart phones over the last several decades. With such devices now more commonplace, it would be easy to think that the semiconductor industry has gone ex-growth and is now simply cyclical. However, we believe that is far from the case. For one, electronic content within devices continues to grow. Despite recent headlines over slowing smartphone sales, semiconductor costs per iPhone have risen from just over $100 in an iPhone 5 to over $160 in the iPhone X. The cost will continue to increase with improvements to screen resolution, processor speed, cameras, sensors, and upcoming 5G modems. But perhaps more importantly, exciting applications for semiconductors are emerging in new growth areas, including automotives and artificial intelligence (AI).

Autonomous Vehicles

The automotive semiconductor market was worth around $42 billion in 2018 and is expected to grow to $100 billion by 2030 (Exhibit 1). The bulk of the growth will be driven by Advanced Driver Assistance Systems (ADAS), which are the brains behind everything from parking assist to fully autonomous systems. While we are used to high-end cars being well-equipped with cutting-edge technologies, these features are filtering through to mainstream vehicles at a much faster pace due to a more competitive car market and increasingly stringent safety regulations. In 2014, just 6% of cars had ADAS features. Today, that number has jumped to 15%.

To understand the economic impact, we can again look at the semiconductor cost per unit. On the high-end, the semiconductor

Exhibit 1: Semiconductor content per car



Source: Credit Suisse

[1] Marshall Fields & Company. (1955). Advertisement for Regency Pocket Radio.

content of a luxury vehicle such as the BMW 7-series exceeds $1000 per car. These features are starting to migrate to less expensive vehicles with common level 2 ADAS features, like automatic emergency braking and blind-spot detection, adding $100 in content to a traditional vehicle. A fully autonomous system requires additional cameras, sensors, and radar, which typically add another $550 of content per vehicle, plus what is needed for connectivity and analytics. The needs of an Electric Vehicle (EV) are even greater, with 2-3x the electronic content to that of a traditional vehicle. As we edge closer and closer to fully automated EVs, the growth potential for semiconductors becomes more apparent.

'Data Is The New Oil'

Artificial Intelligence (AI) is another important area of application for semiconductors. The potential uses of AI are worthy of another article, but range from simple voice recognition and chat-bots to autonomous driving and medical disease detection. More importantly, it is creeping into nearly every industry from retail to health care to mining. However, AI is only possible with the ability to more easily create, store, and transmit large amounts of data. This has, in large part, been achievable due to the wider use of cheaper and more powerful semiconductors.

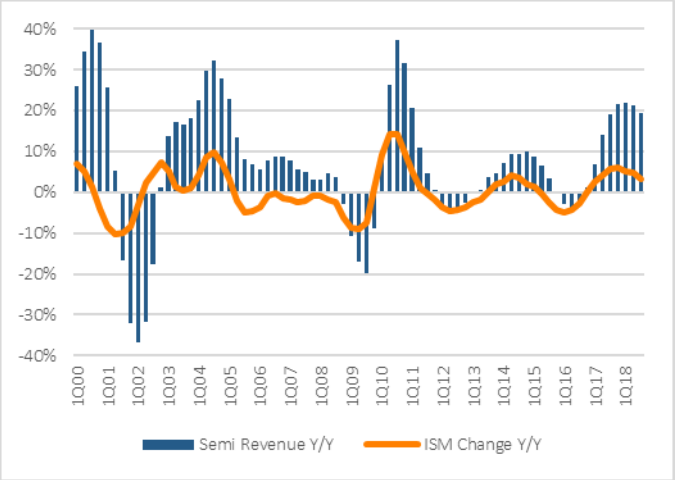
The world around us produces a massive amount of data. To put it into perspective, just one Boeing 787 typically throws off half a terabyte of data per flight, a number likely to increase as more sensors are added to aircraft parts. That pales in comparison to the amount of data created by the internet every day. To capture these data, we have become increasingly reliant on semiconductor-based solid state drives, as opposed to old spinning disks. However, we also need systems that can make sense of these data.

As UK data scientist Clive Humby noted, "Data is the new oil. It's valuable, but if unrefined, it cannot really be used." To "refine" the data, engineers have built systems with new processors and software that can, with a degree of 'training', use algorithms to learn how to make relatively complex decisions. At present, the typical AI system uses a specialized graphics processing unit that requires 6x the memory of the average computer server. From end-to-end, semiconductors play a critical role in capturing, storing, and interpreting the data we generate.

Re-Shaping The Demand Curve

Semiconductors are a core component of all electronic systems, from industrial machinery to computers to household IoT (Internet of Things) devices. As such, they are exposed to the end demand of those devices, and hence, the level of GDP and

Exhibit 2: Semiconductor Revenue (Ex. Memory) vs. ISM Index



Source: Credit Suisse

Industrial Production. However, as more use-cases emerge across a growing variety of industries, we expect that some of the segment's cyclicality will be smoothed by demand that is less correlated. In addition, the industry has improved profitability and there has been significant consolidation over the last eight years after over $300 billion of M&A activity. These two factors combined have vastly improved the industry's pricing power. Given the secular drivers described above and improving industry dynamics, we argue that semiconductors are once again a growth segment, but with diminishing cyclicality.

Edwin C. Davison, CFA, Ph.D., is an Associate Portfolio Manager and Senior Equity Analyst in Dupont Capital's Global & U.S. Fundamental Equity Team, focusing on the Information Technology sector. Prior to joining DuPont Capital in 2017, Mr. Davison was a Senior Investment Analyst, Active Equities at BlackRock. He joined the financial services industry in 1996.

Mr. Davison holds an M.S. in Investment Analysis from Stirling University, a B.S. with first class honors in Chemistry from Imperial College, and a Ph.D. in Organic Chemistry from Cambridge University. He is a CFA charterholder, and accredited as an ASIP (Associate of the UK Society of Investment Professionals) and an ARCS (Associate of the Royal College of Science).

About our firm:

DuPont Capital has a long history of institutional asset management. Our parent company, DuPont (a wholly owned subsidiary of DowDuPont) established a retirement pension plan for employees in 1942, and in 1975 created a separate pension management division.

In 1993, DuPont Capital was established and became an SEC registered investment advisor. We share our parent company's history of innovation and, over the years, have been on the forefront of developing global investment opportunities in both traditional and alternative strategies across equity, fixed income, and alternative investments.

For additional information, please contact:

Mr. Timothy Sweeney
Managing Director
Business Development and Client Service
(302) 477-6083
t.sweeney@dupont.com

Important Disclosures:

The information contained in this memorandum is intended for the sole use of understanding and evaluating the impact of market events and is not designed or intended to be used for any other purpose. The document may contain forward-looking statements, which are based on current opinions, expectations and projections. DCM undertakes no obligation to update or revise any opinions or statements herein. Actual results could differ materially from those anticipated in forward-looking statements. Information contained herein has been obtained from sources believed to be reliable, but DCM does not guarantee the accuracy, adequacy or completeness of such information. An investment in securities includes risk of loss. There is no guarantee that any investment in the securities mentioned will be profitable. Past performance is not indicative of future results.

This document is not intended as an offer or solicitation for the purchase or sale of any security or financial instrument or as a recommendation to invest in any of the securities or financial instruments discussed herein. Registration of an investment adviser with the SEC does not imply any level of skill or training. No part of this presentation may be reproduced in any form.