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Semiconductor War that is Shaping the World

By: Ankur Bisen

An ongoing war over semiconductors has the US and China jockeying for prime position. 'Chip War' pulls off the formidable task of getting readers to understand both the science of semiconductors and the global economics and politics around these critical inputs.

Taiwan's President Tsai Ing-wen recently argued that the island's chip industry is a "silicon shield" that allows it to protect itself from aggressive attempts by authoritarian regimes to disrupt global supply chains. There are no prizes for guessing the "authoritarian regimes" that the president was referring to here.

There are only three foundries in the world that can manufacture leading-edge logic chips. Two of them are not based in the United States and one of these, Taiwan Semiconductor Manufacturing Company Ltd (TSMC), forms the core of the island's "silicon shield". Looking at the role of semiconductors in the Russia-Ukraine conflict, Chinese government analysts have publicly argued that if tensions between the US and China intensify, "we must seize TSMC". Intel is the one foundry that still makes chips in the US, largely because of the paranoia of the late Andy Grove, Intel's co-founder and former chief executive officer, who believed "abandoning today's commodity manufacturing can lock you out of tomorrow's emerging industry".

Chip War reads like a Robert Ludlum spy thriller and the author does not hide this—even before you read the introduction, he introduces you to the "cast of characters" whom you are about to meet. Once you finish the book, the realisation sets in that there was no other way to pull it off than getting readers to understand both the science of semiconductors and the economics and politics of it.

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People in the semiconductor business or technology trade may know most of the cast of characters, the difference between logic and analog chips, and Grove's fears and Jay Lathrop's brilliance. It was Lathrop who laid the foundation for photolithography, the process that manufactures today's nano chips.

It is the post-Covid supply chain disruptions that made the world sit up and take note of the global trade in semiconductors, but by then silicon chips had played a decisive role in shaping the outcome of the Cold War (yes, the Cold War ended, and Silicon Valley won because of chips, argues the book). Chips had also made the Taiwan Strait the most volatile region in the world. The fluency with which author narrates these happenings was not possible without the painstaking research he put into understanding the subject (archived in the book's 50-plus pages of notes).

The book displays the author's enthusiasm to convey what the chip war is to policymakers who have repeatedly showed their inability to grasp the issue in its entirety. He is also keen on conveying this to society at large, which is perhaps blissfully unaware that microchips can shape the discourse of the world and our future in it. Therefore, the book is a fascinating and timely read for all.

Miller understands that to make the *Chip War's* key messages stick, the reader has to understand the science of semiconductors. His efforts to woo the reader shine throughout the book, beginning with his easy-to-understand account on the technical aspects of semiconductors. For instance, the chapter titled "EUV (Extreme Ultraviolet)" explains with clarity and simplicity why semi-conductor manufacturing is a resource guzzler; why it requires infinite precision; and why it is not for the faint hearted. By this time, you know that there is only one company in the world—in the Netherlands—that can supply all the lithography tools to make semiconductors (its evolution into a monopoly is in itself an absorbing sub-plot). Even half a reader who gets to the end will come out significantly informed about the science of semiconductors.

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The book spread over 350 pages takes the reader from the lab and the mind of Nobel Prize-winning scientists in the 1950s and 1960s to the maverick risk takers who staked all for their convictions from the 1970s to the 1990s, and finally to the present state of “weaponised interdependence” that has pitched the US and China against each other while countries such as the Netherlands, Japan, South Korea, and Taiwan take it in from the sidelines. Each of the eight sections of the book has enough meat on the bone to stand alone. Imagine if eight seasons of the “Game of Thrones” were squeezed into a two-hour feature film. *Chip War* is somewhat like that. In places, the author’s narration leaves things unsaid and this tempts you to open the laptop to dig further.

Half way through *Chip War*, its core purpose emerges, which is to make the reader realise there is a hi-tech war going on now between the US and China and that the key weapon in it is the semiconductor. The hegemony of the US in the business and science of semiconductors has taken decades to evolve and it includes allies such as Taiwan. This is a position that deeply troubles China.

World War II saw many innovations emerge that were later put to successful commercial use such as the cavity magnetron that is used in microwave ovens, and the Cold War saw the big powers pour money into building nuclear capabilities. The semiconductor is unique on this count in that it was first developed to gain an advantage in warfare but its subsequent democratisation in society has also become a weapon in the hands of the two biggest economies in the world. The book does not say it, but it is apparent that the chip war is also Cold War 2.0, where the US remains the dominant power but China replaces the former Soviet Union and the semiconductor replaces the nuclear weapon.

The book could not be better timed for readers in India, especially against the backdrop of the announcement that the country’s first chip foundry is to come up in Gujarat. For one, *Chip War* unveils a side of Silicon Valley that is older than its well-known folklore and inventions and is at the bottom of its success story. It also offers much for the Indian reader to reflect on and ponder. First, the book shows that India has missed the semiconductor bus and it can catch it only as an ally of the current lead actors in the global battle. But that will put a lot of strain on India’s doctrine of non-alignment. The reader realises that between China and the US, India is now inclined to side with the Silicon Valley-driven ecosystem of semiconductors because the Soviet Union tried and failed, and China is trying and but not winning. Self-reliance in semiconductors is a mirage and even the US has not achieved it after decades of progress in the field. Being a dominant player in the global trade in semiconductors is an effective deterrent against war and no country can testify to this better than Taiwan.

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Chip War forces us to take note of the fact that semiconductor research and innovation was first backed by public funds. Though the motivation for public funding was not pious (the Cold War, Vietnam War, Gulf War, and so on), it enabled the flow of advanced programmes into public and private universities and institutions, and rewarded and encouraged the scientists and engineers who headed them. This allowed the US to work itself into an almost unbeatable position in the semiconductor industry.

This is a key lesson for India to reflect on given the present state of its public universities and the loud commitments to scientific research and development made by both its state and private sectors. *Chip War’s* crucial lesson is that it is a nation’s approach to science and innovation that gives it an edge in global trade & commerce, be it in semiconductors or anything else. Right now, India produces the best rhetoric but lacks the edge it needs to stand out.

This brings us to the second insight that the book offers about innovation in the semiconductor business. Science and innovation thrive in an environment like that of the US, which fosters liberal and democratic values. Though the Soviet Union poured money into chips in the 1980s and China is doing so now, both lack the liberal order that allows unhinged flights of the imagination. The US has never lacked this.

This points to why transgender scientist Lynn Conway had the freedom to express both her identity and her imagination and team up with goatee-sporting professor Carver Mead at Caltech to standardise chip manufacturing. This created conditions for Morris Chang to return from the US to Taiwan and set up the foundry that is at the heart of Taiwan’s silicon shield. The book offers enough clues to indicate that while the supply chain of semiconductors may be global, the US, particularly Silicon Valley, will be at the heart of the trade for the foreseeable future.

Chip War can be a humbling read for Indians. Today, the semiconductor business is a big boys club of entities that can be counted on the fingers of one hand, and they are chasing a rapidly maturing market. Semiconductors have also reached a stage where the line

between its existence as an industry and as a tool for geopolitics between the US and China is blurred. Breaking into this club will require an unending supply of money and a hard position on geopolitics, both of which India can ill afford.

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We can at best aspire to be a fringe player to the big boys. The other option is to imagine something so out of the ordinary that it entirely takes the game away from semiconductors. Manufacturing semiconductors is a resource guzzling process that comes at a steep cost to the environment. The industry also has been built on labour arbitrage and its compliance with fair labour practices till now is anyone's guess. But new areas are emerging where India can play a decisive role early on through design and innovation, particularly in climate change, material science, health care, and food security.

However, without strengthening public universities, deploying public funds for bold scientific research programmes, and reinforcing the virtue of the scientific temper lauded in our Constitution, we may miss the bus yet again. This is perhaps my most important takeaway from *Chip War*.

You can finish the book in two days or savour it for days, depending on how much you want to extract from it. I would suggest the latter because in doing so you can reflect on many “what if” moments. The decision of a potato farmer in Idaho to enter the memory chip manufacturing business because of a contrarian belief eventually led to the rise of Samsung as a dominant chip manufacturer, and the decision of Texas Instruments to bypass Chang for its CEO position led to the rise of TSMC in Taiwan. These are two of my favourite “what if” moments from the book.

The broad canvass of the book forces Miller to keep the narrative simple and concise, but in doing so, he is compelled to abruptly conclude the build-up in many places. Part Eight of the book seems its weakest section but it is also the most important in today's context. A part of this has to do with that many aspects mentioned in it are still evolving and the author's point of view is contingent on various factors. For instance, the chapter titled “The Assault on Huawei” makes no mention of the arrest of Huawei's Chief Financial Officer Meng Wanzhou (also the daughter of Huawei's founder) in Canada and the three-year diplomatic stand-off that followed. Miller relies on conjectures at many places that experts on geopolitics may find one dimensional. But in doing so he lays the ground for another book that could dig deeper into the hypotheses articulated in this section.

Chip War is an essential read for anyone who has a stake in geopolitics, international relations and trade, defence and warfare, science and technology, economics, commerce and industry, and higher education because it can clarify many misplaced notions and beliefs. Especially now that the US has expanded restrictions on the export of advanced semiconductors and manufacturing equipment to China and stepped up restrictions on American personnel and firms supporting Chinese chip making. Enthusiasts and students will enjoy the book if they read it without any prejudices and soak up all the information it has to offer. Semiconductors are an incredible amalgamation of electrical engineering and solid-state physics and if this book can speak to a wide audience on a subject such as this, it has done its job with flair.

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