Sourcing analytics: A playbook for global supplier exploration and selection

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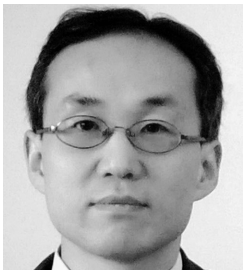

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Abstract

This paper provides a playbook for sourcing analytics, that is, exploring and selecting suppliers globally for critical components using analytics and publicly available data. The practitioners' playbook presents a step-by-step procedure, from defining supplier selection criteria that match the company's strategic goal, to supplier intelligence for identifying potential suppliers globally, bargaining power analysis for measuring leverage and supplier benchmarking for comparing and selecting the suppliers that best meet the criteria. We showcase the application of this playbook through the example of central processing unit (CPU) sourcing for Apple's iPhone.

Keywords

sourcing analytics, supplier exploration, supplier selection, data analytics, data visualisation, playbook, supplier intelligence, bargaining power analysis, supplier benchmarking

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INTRODUCTION

Global sourcing can contribute significantly to a company's financial success. Cost of goods sold (COGS) is a major expense, accounting for a much larger percentage of revenue for most industries than net income.[1] Thus, even a small saving in COGS can translate into a huge gain in the net income and thus stock market performance. Sourcing, especially high-value and critical components, is also a method of innovation.

Global sourcing is a challenging task because of the large, diverse and changing supply base. A typical company may spend millions of dollars on hundreds of thousands of stock-keeping units (SKUs) from thousands of suppliers, thus sourcing is data-driven. Meanwhile, the constant emergence of new suppliers, along with mergers and acquisitions (M&A), requires frequent adjustment of a company's supply base. Hence, data analytics is critical in developing the insights and intelligence needed to support sourcing decisions.

Given the wealth of data, knowing where to start, what to analyse and how to interpret can be a daunting task. In this paper, we provide a step-by-step playbook that is easy to follow for sourcing analytics. The playbook lays out steps in utilising publicly available data (ie financial data reported to stock exchanges) to explore and identify the right suppliers, support better negotiation and bargaining with the suppliers and facilitate new supplier development, new products and services procurement.

We showcase the playbook through microprocessor (CPU) chip sourcing for Apple's iPhone. The iPhone was the first touch-screen smartphone and made Apple US$27bn with a profit of US$15.6bn during 2007–10.[2] The iPhone remains a major source of revenue for Apple through the first quarter of 2024, at which time about 58 per cent of Apple's revenue was from the iPhone.[3]

Apple's global sourcing contributes significantly to its financial success. While creative design and engineering are developed in-house, manufacturing is mostly outsourced. Apple's global supply chain engages thousands of suppliers in over 50 countries.[4] Samsung was Apple's CPU chip supplier before it became a major competitor, overtaking Apple in the global smartphone market by volume.

This incident highlights the importance of supplier selection on critical components for Apple to continue its success with the iPhone. In this paper, we illustrate how Apple could use the sourcing analytics playbook to aid in its exploration and selection of suppliers globally for CPU chips.

SOURCING ANALYTICS: A PRACTITIONER'S PLAYBOOK

The sourcing analytics playbook consists of the following four steps:[5]

1. Assess the company's needs and define the supplier selection criteria.
2. Explore and identify potential suppliers by supplier intelligence.
3. Assess negotiation power by bargaining power analysis.
4. Compare and select suppliers through supplier benchmarking.

Step 1: Assess needs and define selection criteria

In Step 1, we assess the company's sourcing needs and define the supplier selection criteria accordingly.

Objective

Align the supplier selection criteria with the company's strategic objectives.

Methodology

- *Industry analysis*: Understand the overall industry potential and trend.
- *Competitive positioning:* See where the company stands in the competitive landscape.
- *Breakdown analysis*: Break down the revenue into cost components to identify top priorities.

The priorities, combined with the needs assessment, help a company determine how suppliers can support its operating structure and market strategy. Does it need suppliers capable of scaling alongside its growth trajectory? Does the supplier need to be innovative? Are suppliers' costs a driving factor? Answers to these questions help a company define the supplier selection criteria that meet the company's needs. In general, the selection criteria address the company's needs on supplier capability, cost and risk.

Industry analysis

A trend analysis of the technology hardware and peripheries sub-industry (including providers of smartphones like Apple) in Figure 1 shows that up to 2023, this sub-industry experienced continuous growth in the US. When comparing revenue and profits across the US, South Korea and Japan, the US boasted the highest figures and benefited from the COVID-19 pandemic with a sharp increase in 2021. Post-pandemic the revenue and profits were subsiding.

Competitive positioning

Figures 2 and 3 show that Apple leads in revenue and operating income among all US-based S&P500 information technology (IT) companies in 2023.

Breakdown analysis

Figure 4 shows the revenue breakdown of Apple, Dell, HP and the US technology hardware industry as a whole in 2023. We can see that Apple performed the best on COGS with 56 per cent of its revenue spent on COGS, compared to Dell at 78 per cent, HP at 79 per cent

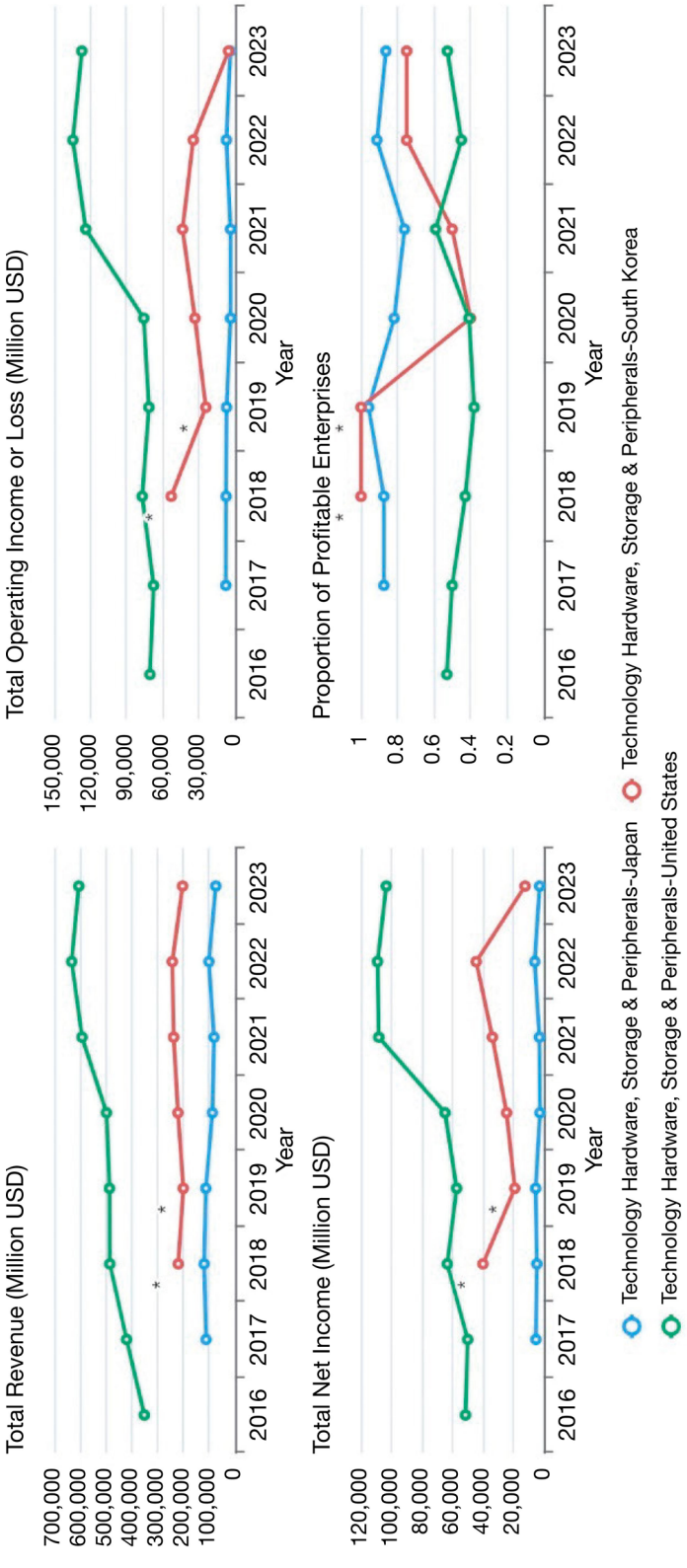

FIGURE 1 Technology hardware industry trends in the US, South Korea and Japan[5]

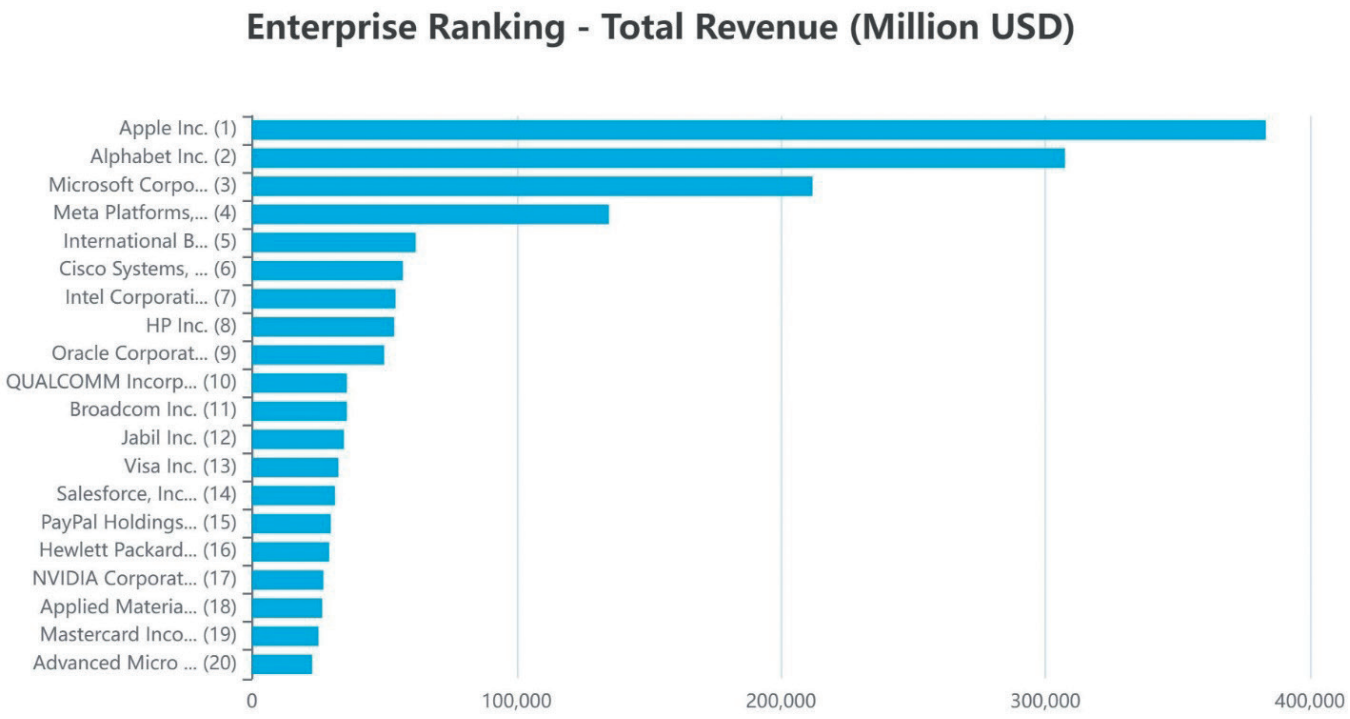

FIGURE 2 S&P500 IT companies by revenue, 2023[6]

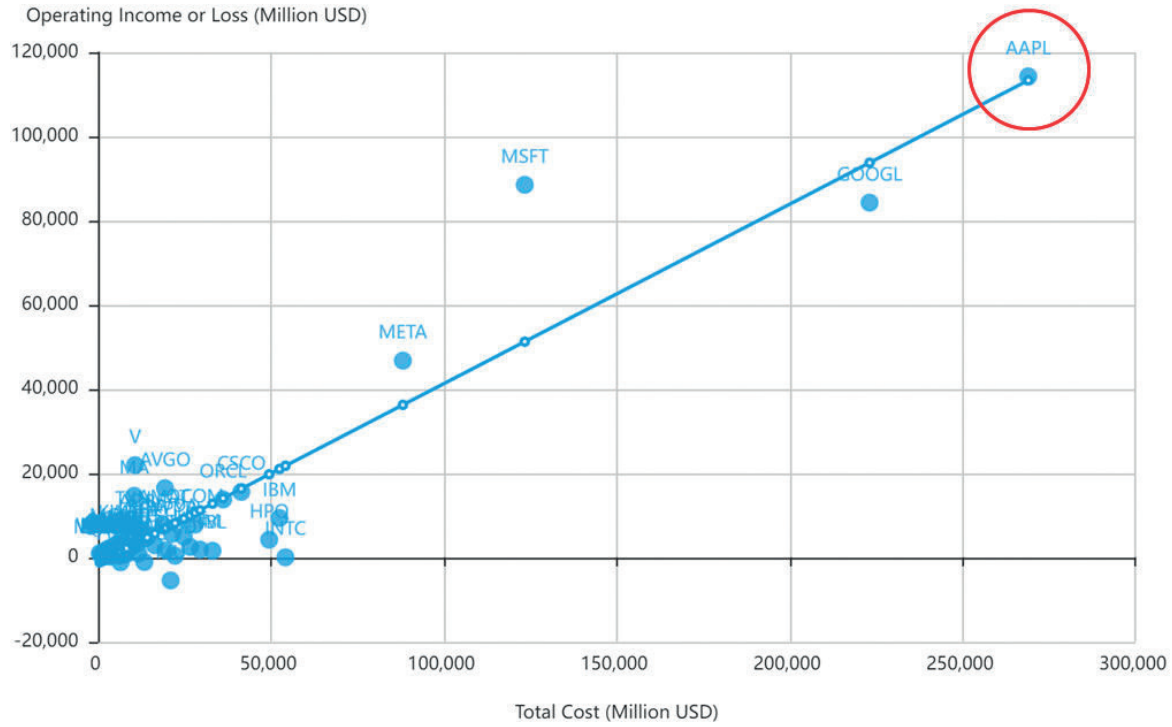

FIGURE 3 Operating income versus total cost for S&P500 IT companies, 2023. AAPL is Apple's ticker symbol[8]

and the industry average of 63 per cent. That said, COGS is still the biggest cost component and therefore a priority of Apple in sourcing. It is also notable that Apple has the largest research and development (R&D) expense and smallest selling, general and administrative expenses (SG&A) as a percentage of the revenue among these companies.

Apple's strategic focus over the past two decades has been innovation, product quality and brand loyalty.[7] Combining this knowledge with Apple's position in the market and the revenue breakdown, we can define Apple's supplier selection criteria in Table 1.

Step 2: Identify potential suppliers

In Step 2, we explore and identify potential suppliers globally using supplier intelligence.

Objective

Explore and identify potential suppliers.

Methodology

- *Supply chain mapping*: Map out and visualise the supply chain.
- *Business geographic information*: Identify countries or regions with the strongest supplying industry.
- *Market trend and concentration*: Study the trend, competition intensity (competitive versus monopolised) and major players of the supplying industry.

Supply chain mapping

To illuminate Apple's relationship with the global semiconductor industry, we map out the semiconductor supply chain in Figure 5, where we can see that the semiconductor industry supplies many

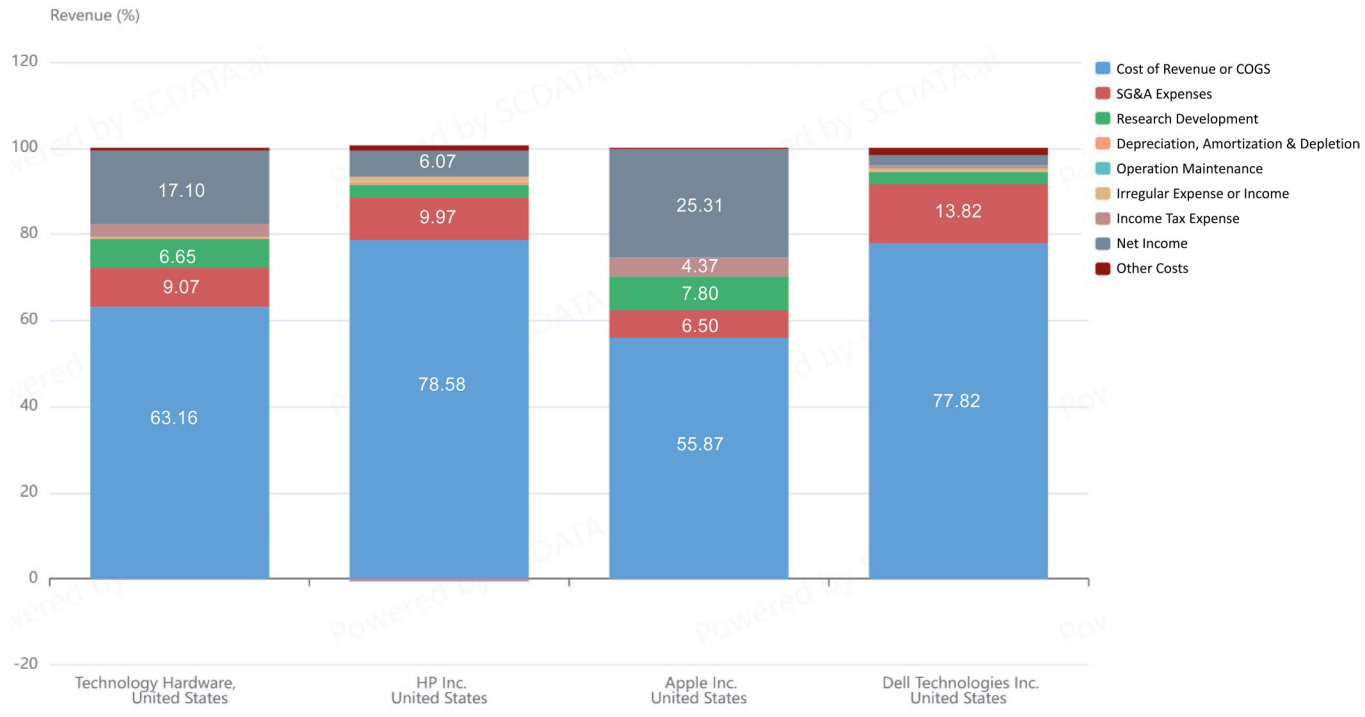

FIGURE 4 Revenue breakdown of Apple, Dell and HP, 2023[9]

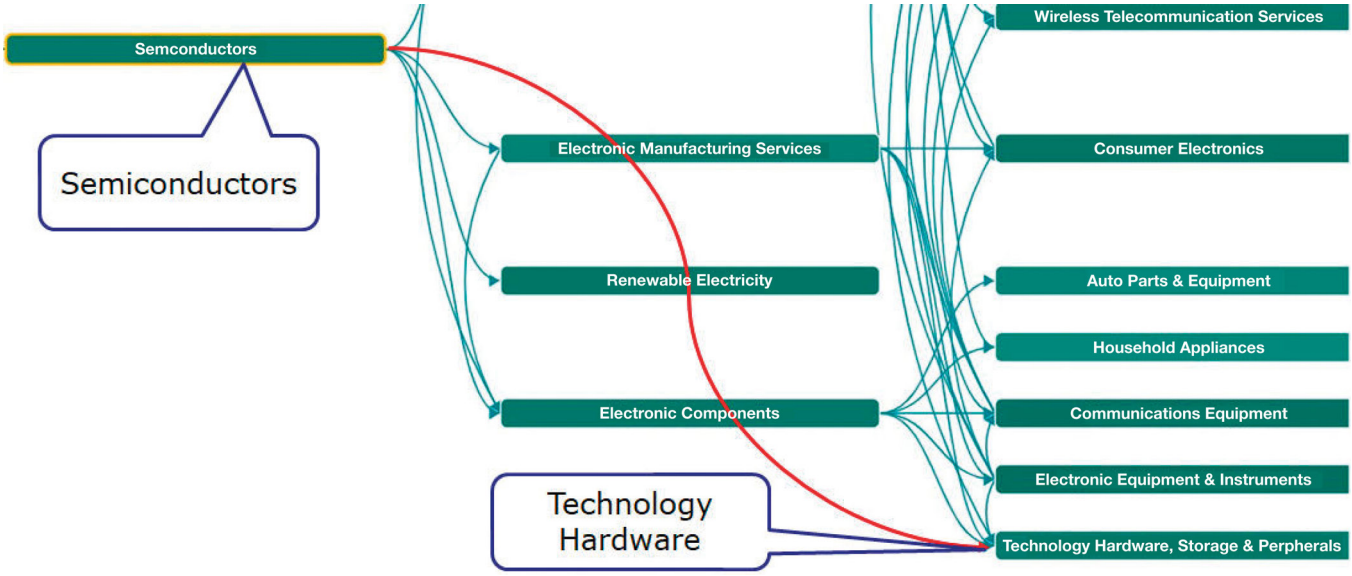

FIGURE 5 Supply chain mapping of semiconductor and technology hardware industries[10]

TABLE 1 Supplier selection criteria for iPhone CPU

No.	*Supplier Selection Criterion*	*Needs Addressed*
1	Innovative and technological capability	Technology, supply capability
2	Production and supply chain capability	
3	Pricing and profitability	Cost saving
4	Bargaining power	
5	Financial health	Risk
6	Leaks and competition	

downstream industries, including technology hardware (to which Apple belongs), automotive and consumer electronics.

Business geographic information

The semiconductor industry encompasses companies engaged in the design and fabrication of semiconductors and semiconductor devices. While the industry operates on a global scale, it is predominantly clustered in a small number of regions including North America, the Indo-Pacific and Western Europe (see Figure 6).

The bar chart in Figure 7 zooms into countries with the largest semiconductors industry by revenue, guiding us on where to look for semiconductor suppliers. These countries are the US, China, Taiwan, South Korea and Japan. Notably, semiconductor revenue from China and Taiwan each accounts for more than 50 per cent of the US revenue. We exclude South Korea from our analysis because it did not make the list in 2022, whereas the US, China, Taiwan and Japan consistently rank at the top.

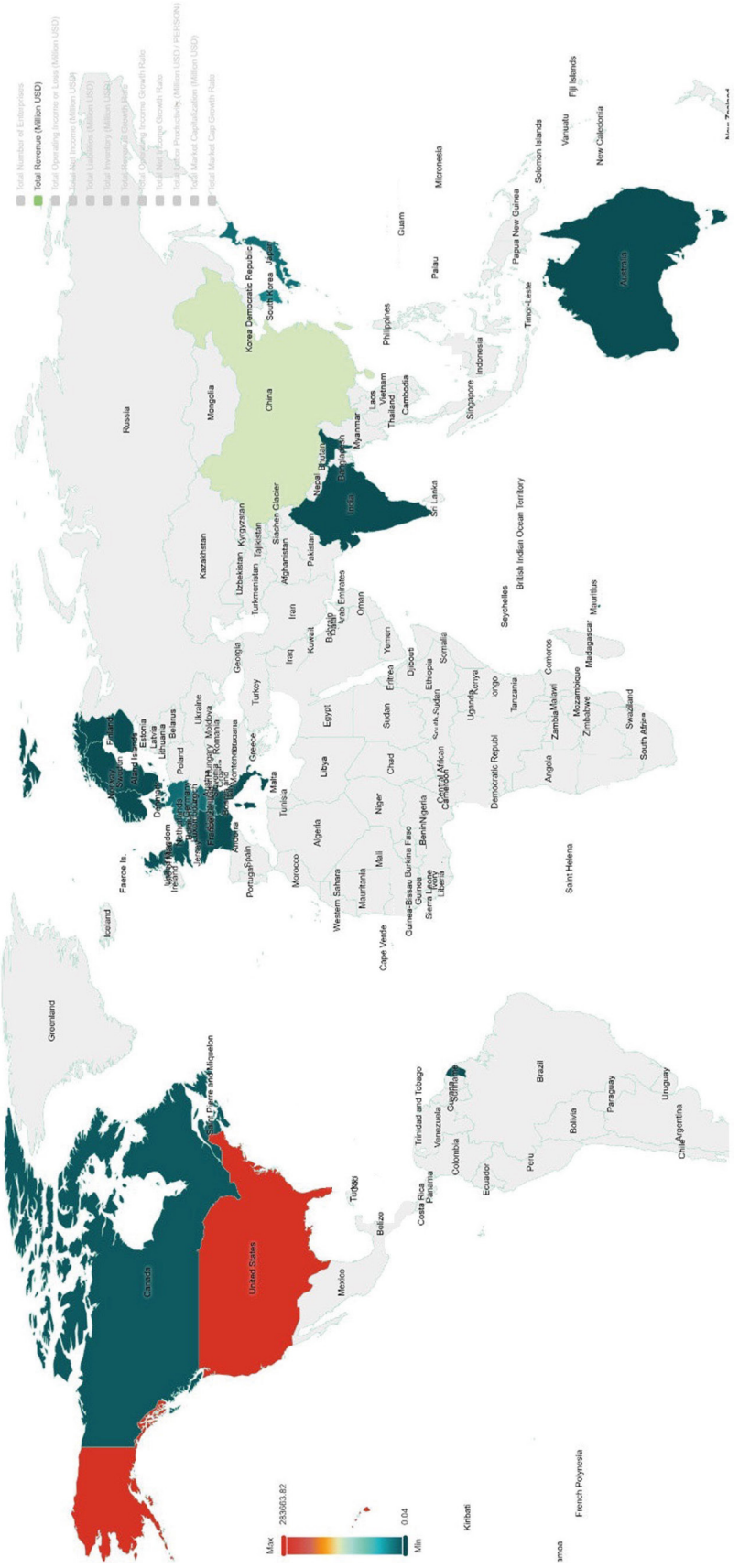

FIGURE 6 Global semiconductors enterprise distribution, 2023[11]

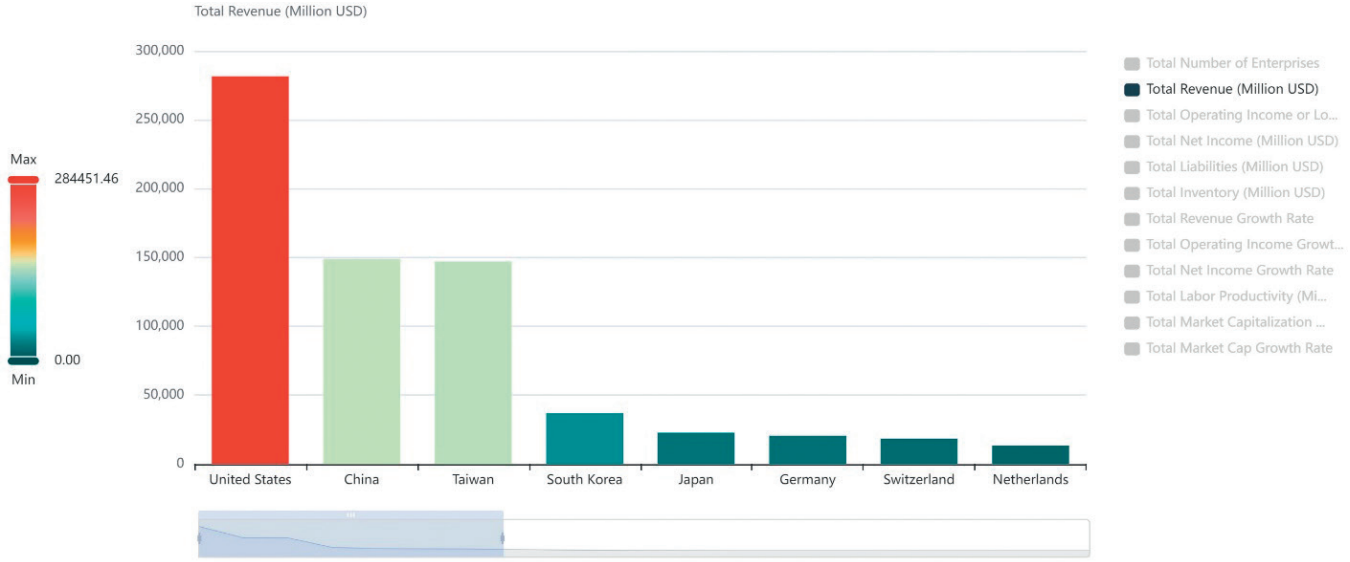

FIGURE 7 Countries with the largest semiconductors industry by revenue, 2023[12]

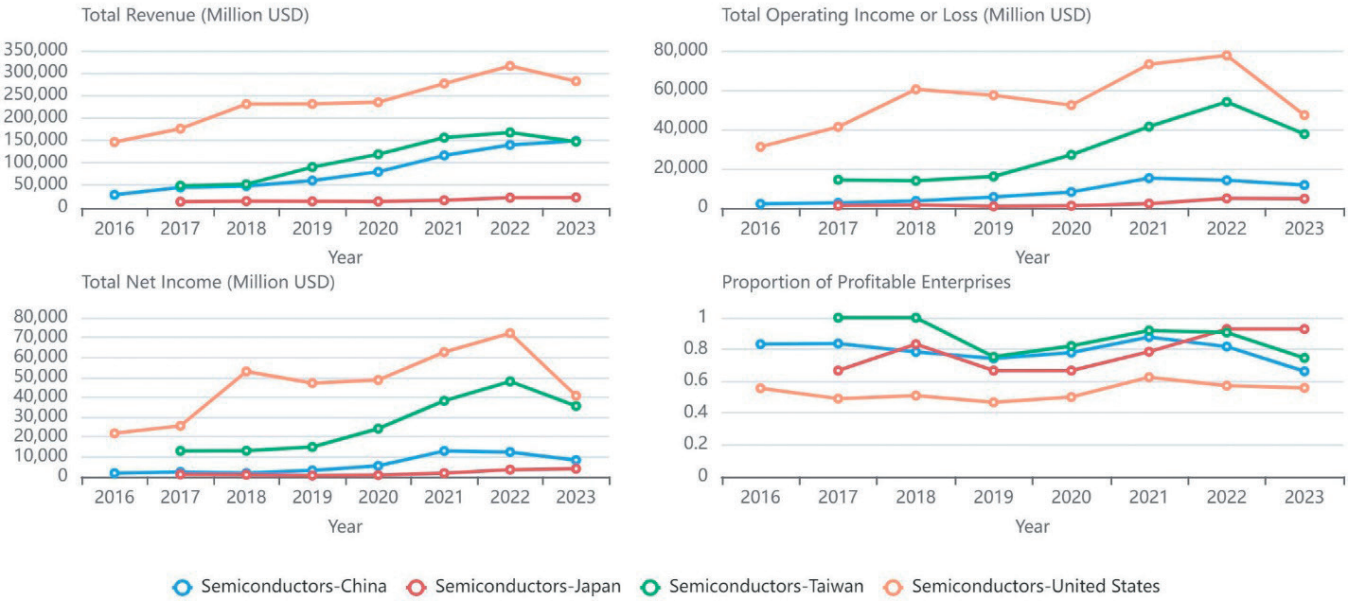

FIGURE 8 Semiconductor revenue trends: Analysis of the top four countries[13]

Market trend and concentration

To gain a better understanding of the performance of the top countries and their prospects, we proceed with an industry trend analysis of total revenue, operating income, net income and the proportion of profitable enterprises from 2016 to 2023. Figure 8 shows that the US consistently performed the best in both revenue and profits, exhibiting fast

growth overall. Taiwan emerged as a significant contender in both revenue and profits. China is large in revenue but weak in profits.

Next, we conduct a market share analysis focusing on two countries, the US and Taiwan, to reveal the major companies and the competition intensity. The analysis of the US semiconductor industry indicates a relatively stable market share distribution, with the market being relatively competitive from 2016–23, characterised by a few dominant players alongside numerous smaller competitors. Figure 9 shows that key players include Intel, Qualcomm, Micron, TI and Broadcom. In contrast, the semiconductor market in Taiwan exhibits higher concentration, albeit becoming more competitive in recent years, with Taiwan Semiconductor Manufacturing Corporation (TSM) retaining its leading position.

Lastly, the enterprise ranking by total revenue in the global semiconductor industry highlights several promising suppliers for CPU chips (see Figure 10). In 2023, TSM surpassed Intel and became the largest semiconductor manufacturer globally. Our selections encompass seven companies including TSM, Intel, Qualcomm (QCOM) and Broadcom (the top four revenue performers in 2023), along with AMD and Texas Instruments (TXN, renowned chip makers) and GlobalFoundries (GFS, selected for diversification). We excluded NVIDIA due to their focus on graphics processing units (GPUs), and Micron due to their specialisation in memory chips.

Step 3: Bargaining power analysis

In Step 3, we conduct a bargaining power analysis on the buyer company and its potential suppliers to measure their leverage and negotiation power.

Objective

Assess leverage and negotiation power.

Methodology

- *Leverage assessment*: Assess the leverage of a company and its suppliers.
- *Bargaining power index*: Measure the relative negotiation power of the company and the suppliers.

Leverage assessment

Intuitively, a company's negotiation power depends on its buying or selling volume. For instance, if a buyer buys 50 per cent of a seller's sales volume in a category, which accounts for only 5 per cent of the buyer's spend in the category, the buyer has more negotiation power over the seller. This is because if there is no deal, the seller then loses 50 per cent of their sales, whereas the buyer only loses 5 per cent of supplies. Reversely, if the buyer buys 5 per cent of the seller's sales volume in a category which accounts for 50 per cent of the buyer's spend in the category, then the seller holds the upper hand in negotiations. In such a scenario, if there is no deal, then the seller loses a mere 5 per cent of the sales, while the buyer suffers a 50 per cent shortfall in supplies. Based on the intuition, the leverage of a buyer and a seller in a category can be calculated as follows:

- Buyer leverage = percentage of the seller's sales in the category that the buyer purchases.
- Seller leverage = percentage of the buyer's total spend in the category the seller provides.

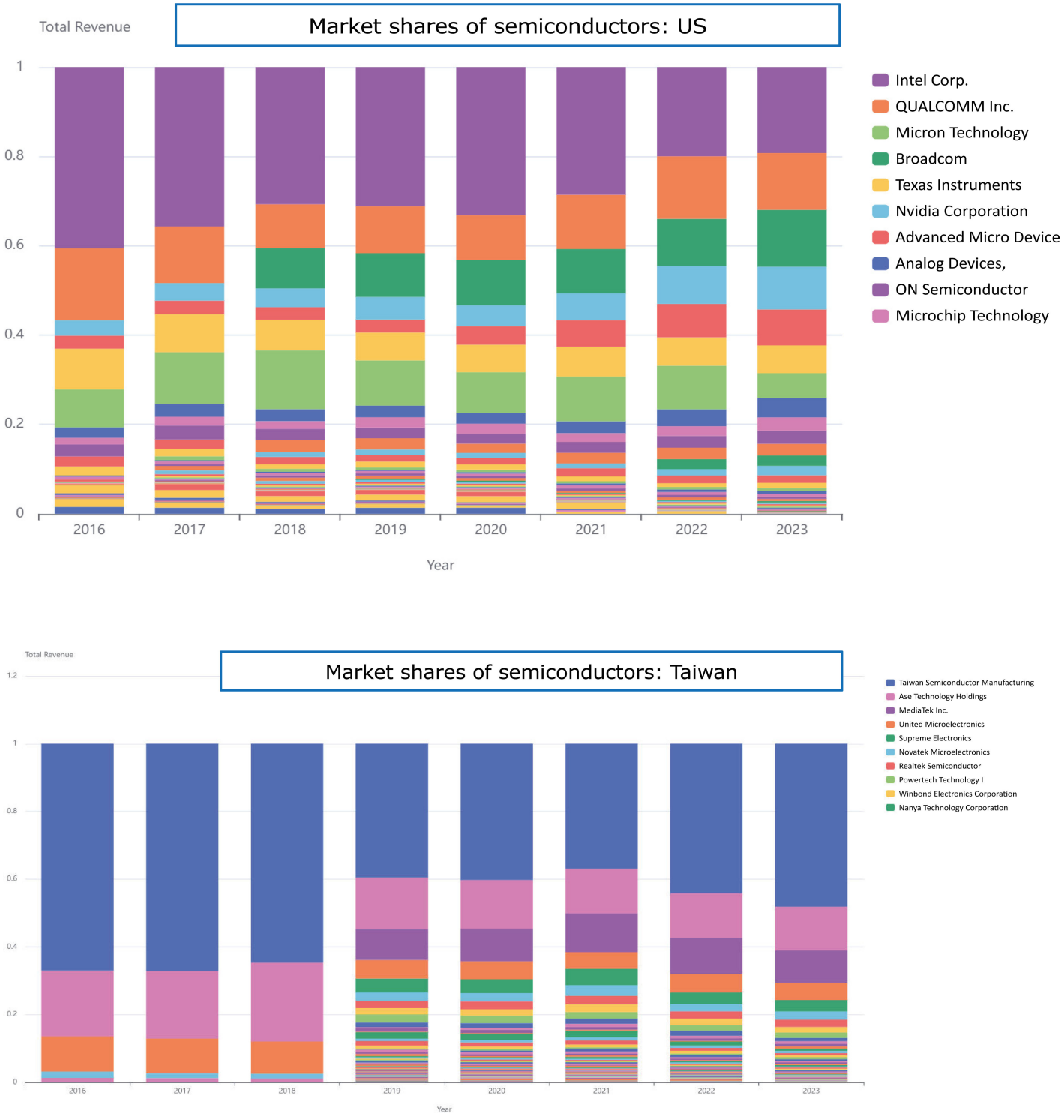

FIGURE 9 Market share analysis: US (top) versus Taiwan (bottom)[14]

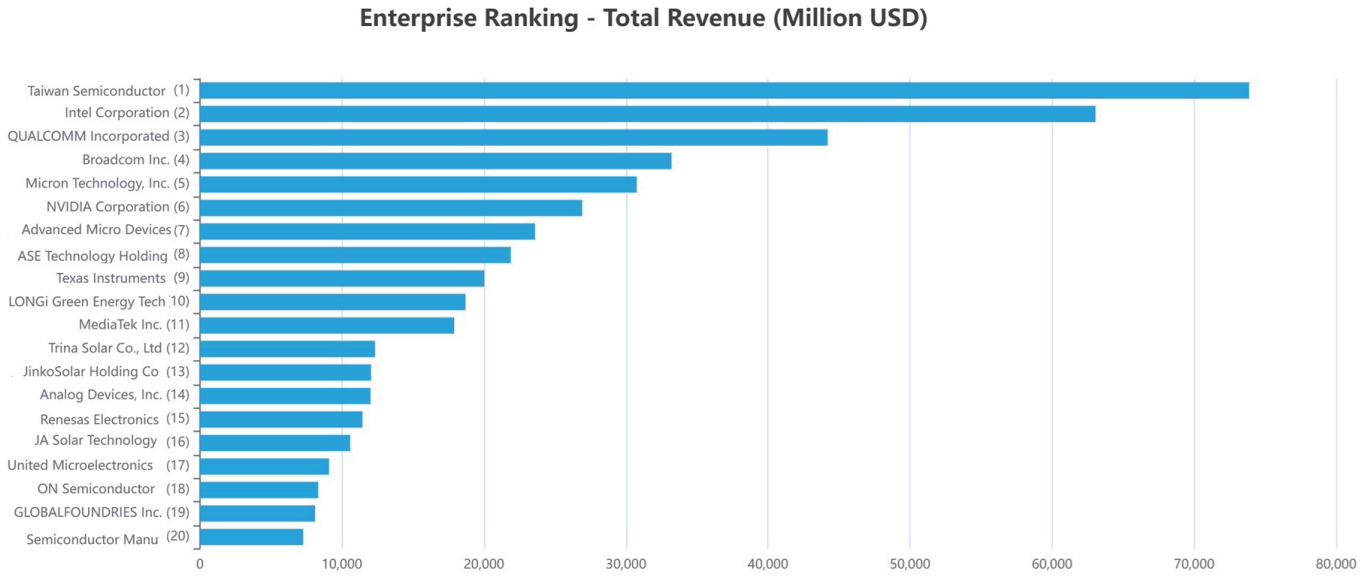

FIGURE 10 Enterprise ranking of semiconductors by total revenue, 2023[15]

The buyer (or seller) leverage measures the importance of the buyer (seller) with respect to the seller (buyer).

Bargaining power index

The bargaining power index (BPI) is the ratio between the buyer's leverage and the seller's leverage. That is:

> BPI = buyer leverage/seller leverage = buyer's total spend in the category/seller's sales in the category

Table 2 gives two examples of bargaining power analysis. If the BPI is much greater than 1, then the buyer holds the bargaining power because the seller needs the buyer more than vice versa. Conversely, if the BPI is much smaller than 1, the seller holds the bargaining power because the buyer depends more on the seller. If the BPI is about 1, then the bargaining power is balanced as the buyer and seller rely on each other equally. Note that the calculation of BPI does not require the data of the buyer's spend for a specific seller, which can be hard to obtain.

Apple's total spend on semiconductors in 2022 is US$67.06bn. We can easily retrieve the total sales data for the seven selected semiconductor suppliers in 2022. Then we can calculate Apple's BPIs with these suppliers as follows.

Table 3 shows that TSM has more negotiation power over Apple, but Apple has more negotiation power over all potential semiconductor suppliers other than TSM.

Step 4: Supplier benchmarking

In Step 4, we perform a supplier benchmarking analysis to compare the potential suppliers and select the best supplier(s) meeting the selection criteria.

Objective

Compare the potential suppliers side-by-side on the supplier selection criteria.

TABLE 2 Examples of bargaining power analysis

	Buyer's purchase	*Seller sales in the category*	*Buyer spend in the category*	*BPI = buyer leverage/ seller leverage*	*BPI = buyer's total spend in the category/seller's sales in the category*
Scenario 1	50k	100k	1M	50%/5%=10	1M/100k=10
Scenario 2	50k	1M	100k	5%/50%=0.1	100k/1M=0.1

TABLE 3 Apple BPIs with semiconductors suppliers, 2022

Semiconductors supplier (Ticker)	*Supplier's revenue $M*	*BPI*
Advanced Microdevices (AMD)	23,601	2.84
GlobalFoundries Inc. (GFS)	8,108	8.27
Intel (INTC)	63,054	1.06
Qualcomm (QCOM)	44,200	1.52
Texas Instruments (TXN)	20,028	3.35
Broadcom (AVGO)	33,203	2.02
Taiwan Semiconductor Manufacturing Co. (TSM)	73,868	0.91

Note: The calculation assumes that 100 per cent of the seller's sales are within the category

Methodologies

- *Pricing and profitability analysis*: To understand the value added (technology, innovation), pricing and profitability of the suppliers.
- *Financial health analysis*: To assess the short-term and long-term liabilities and risks of the suppliers.
- *Production and supply chain capabilities*: To assess the suppliers' production and supply chain capabilities.

Pricing and profitability analysis

One way to measure a company's technology and innovation is through its gross margin, which quantifies the value added. High value-added products typically have high pricing and thus a high gross margin. To measure profitability, we use net margin. An ideal supplier (for a long-term relationship) can offer attractive pricing to the buyer and sustain the offer because of their profitability. On the contrary, a deceptive supplier offers attractive pricing but is barely profitable. Thus they may look favourable initially but are actually a bad choice because they may ultimately burden the buyer with potential costs through higher prices or even bankruptcy.

Figure 11 shows the revenue breakdown of the potential semiconductor suppliers which can be split into two groups. The first group includes AMD, Intel and GFS, which have lower pricing (due to their higher COGS as a percentage of the revenue, or equivalently, lower gross margin because they use similar suppliers for production equipment and raw materials) and are still profitable. The second group includes TXN, Broadcom, QCOM and TSM, which have much higher pricing and are highly profitable.

How can a supplier simultaneously offer attractive pricing to its buyers and be highly profitable? This can be achieved by improving the operational efficiency. Comparing TSM to TXN, for instance, we can see that TSM has a lower gross margin (due to a higher COGS/revenue) and thus a lower pricing

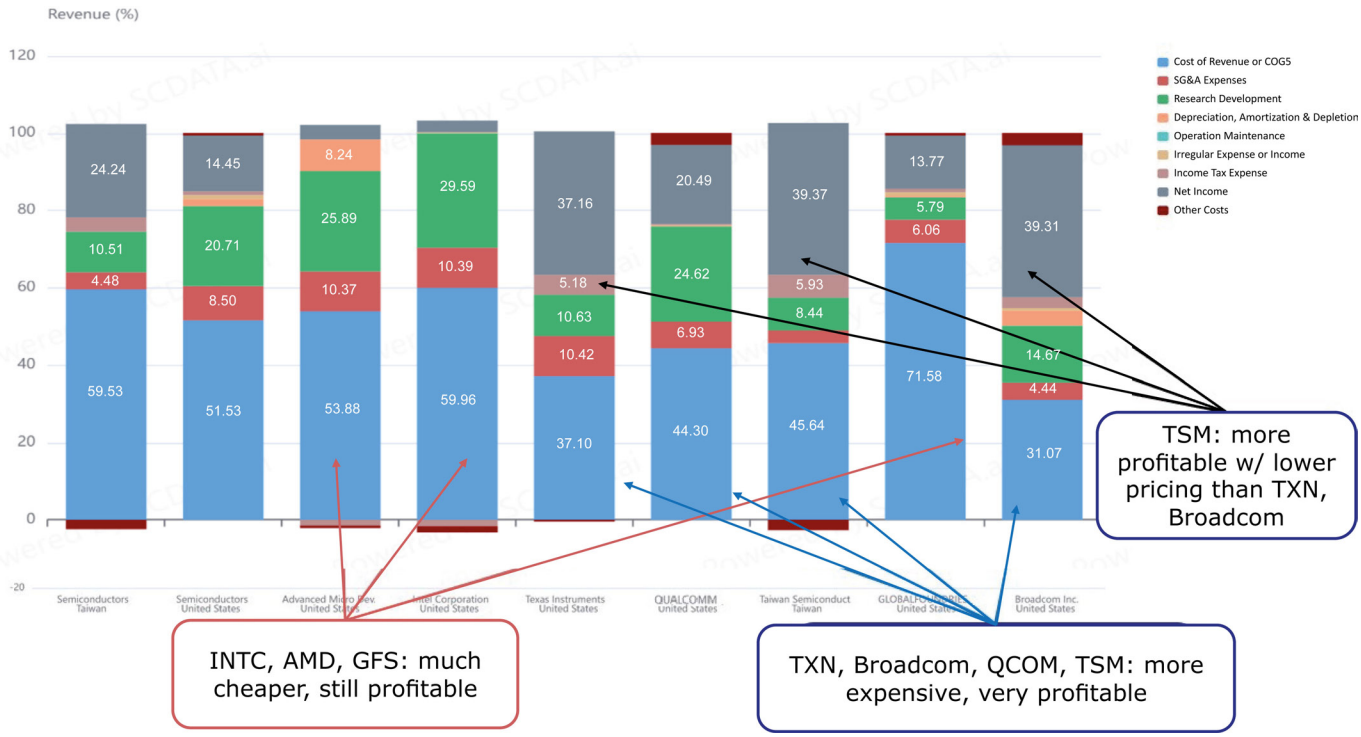

FIGURE 11 Revenue breakdown of the potential semiconductor suppliers, 2023[16]

but a higher net margin. TSM achieved this by squeezing its SG&A to about 3.3 per cent of revenue, which is the lowest among all peers, and much less than the industry averages of Taiwan (4.48 per cent) and the US (8.94 per cent).

Financial health analysis

For critical components, the buyer needs the suppliers to have rock-solid financial health, to avoid the trap of a good one-time deal but long-run crisis. That is, suppliers may entice a buyer with heavy discounts to get the buyer indoors, but the supplier may threaten bankruptcy, leaving the buyer to bear the consequences. Therefore, conducting thorough data analysis on equity, liability and risk is important for the buyer to understand the supplier's financial health in both the short and long terms before making sourcing decisions.

There are many ways to quantify and compare short and long-term risks. The most straightforward way is an equity and liability analysis to shed light on the breakdown of the companies' total assets into equity, current (short-term) and non-current (long-term) liabilities. Figure 12 shows that in comparison, QCOM and Broadcom have the highest total (current and non-current) liabilities, while all others are very healthy and have low liabilities with shareholder equity accounting for more than 50 per cent of the total assets.

Production and supply chain capabilities

For critical components, the buyer needs to ensure that the suppliers have sufficient

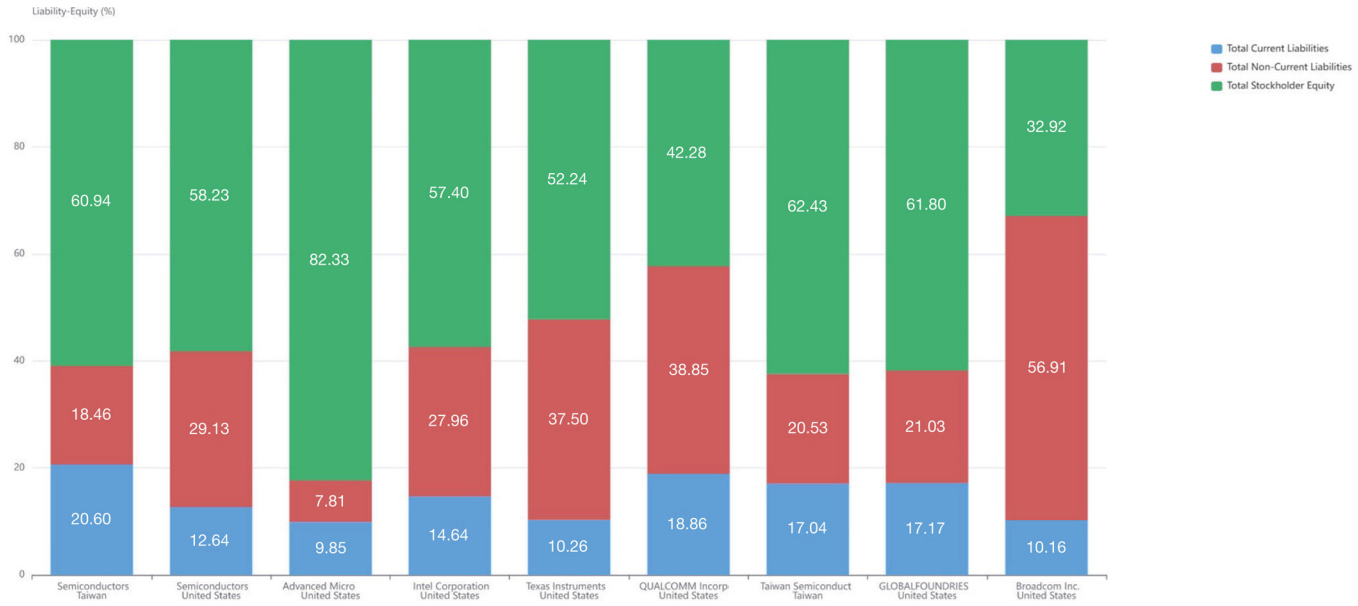

FIGURE 12 Equity and liabilities breakdown of the semiconductors suppliers, 2023[17]

production capability and can secure the necessary production equipment and raw materials. Otherwise, the suppliers may struggle to provide sufficient quantities and be responsive to changes in the buyer's demand. To measure a supplier's production capabilities, we use the 'property, plant and equipment' (PPE) measure.

A detailed breakdown of the total assets of the potential semiconductor suppliers for Apple, shown in Figure 13, categorises the suppliers into three types: (1) integrated circuit (IC) designer; (2) IC fabricator; and (3) combined IC designer and fabricator. AMD and Broadcom are clearly IC designers with PPE accounting for 3 per cent of the total assets, and the net intangible asset, such as intellectual properties, comprising about 70 per cent. TSM and GFS are IC fabricators, with PPE making up more than 55 per cent of the total assets, and the net intangible assets less than 2 per cent. Intel and TXN are combined IC designers and fabricators because they have strong production capacity, with PPE representing about 30–50 per cent of their total assets and significant net intangible assets of 14–16 per cent. QCOM leans more towards being an IC designer than an IC fabricator, with PPE at about 10 per cent of the total assets and net intangible assets approximately 24 per cent.

While the asset breakdown reveals the relative strength of a company in design and production, it lacks information on the absolute values of the PPE. A trend analysis can make up for the missing, but vital, information. Figure 14 (lower graph) shows that GFS, TSM and Intel have the highest PPE as a percentage of their total assets; however, in absolute value (upper graph), TSM and Intel significantly outperform GFS and all other suppliers.

In terms of supply chain capability, Intel is the strongest supplier. As one of the largest shareholders of the leading chipmaker ASML (Intel held 15 per cent of ASML in 2012, and still 3

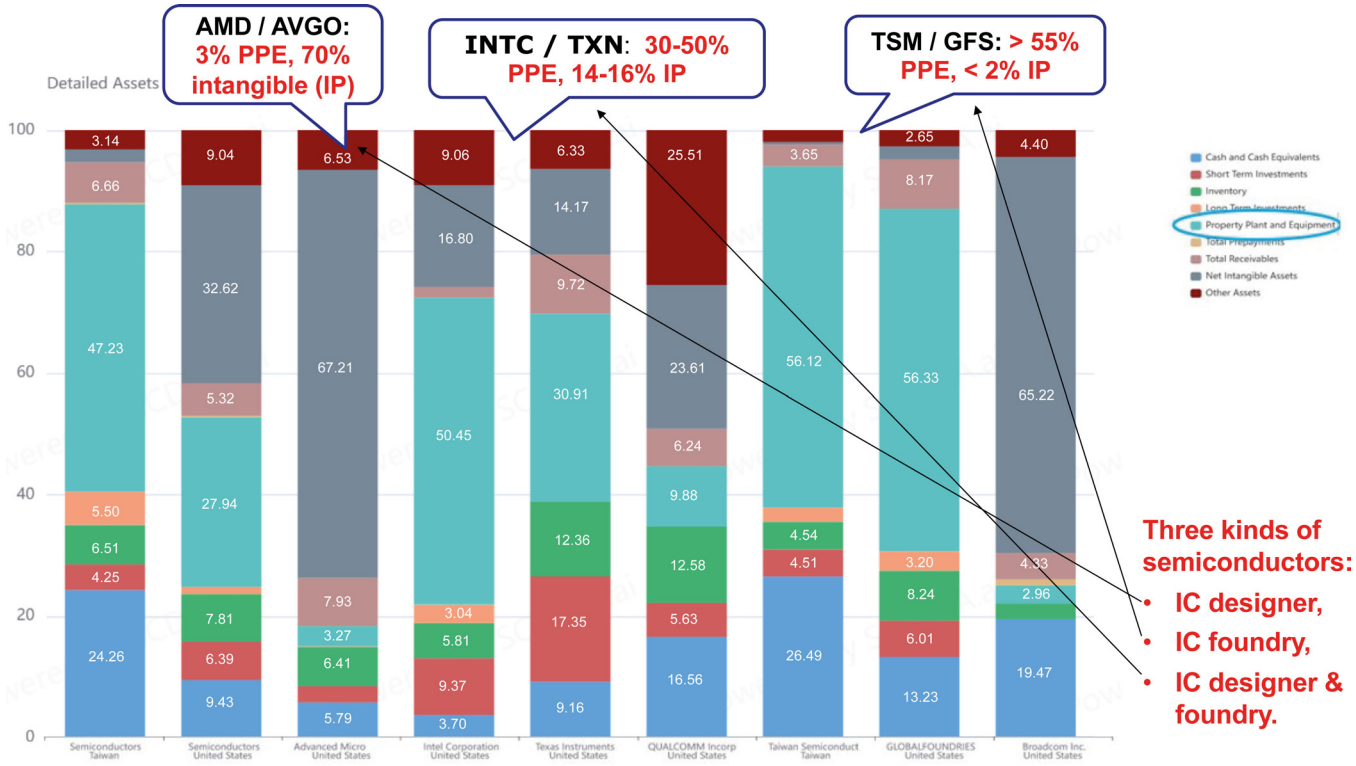

FIGURE 13 Assets breakdown of semiconductors in the US and Taiwan, 2023[18]

FIGURE 14 Comparison of PPE among semiconductor companies[24]

per cent in 2023, while Samsung's 2023 share is 1.6 per cent, TSM 0 per cent[19]), Intel has the priority in getting ASML's lithography equipment. For example, the world's first extreme ultraviolet radiation high numerical aperture (EUV High NA) went to Intel in January 2024.[20] ASML is the only supplier of high-end lithography machines and thus it is highly sought after and had a backorder of 1.4 years as of January 2024.[21]

A breakdown of TSM's 2021 sales by customers[22] shows that its largest customers are Apple, AMD, QCOM and Broadcom. It is understandable because AMD, QCOM and Broadcom have insignificant production capacity and outsourced their chip production to TSM. Thus outsourcing chip production to AMD, QCOM and Broadcom is equivalent to outsourcing chip production to TSM. On the other hand, Intel has launched its own foundry, called Intel Foundry Service (IFS), and it is quickly advancing its fabrication process to 2nm by the end of 2024.[23] INTC announced its intention to make chips for AMD, Google, NVIDIA and QCOM.[25]

Supplier scorecard

In this section, we summarise the results of all the analyses in the above sections into scorecards for the potential suppliers to determine the best supplier(s) meeting the selection criteria (see Appendix for the scorecard of each potential supplier). Combining these scorecards into one table, we can provide a side-by-side comparison among all potential suppliers on the supplier selection criteria in Table 4.

The weight assigned to each criterion determines the 'winners'. Assuming equal weights, Table 4 shows that Intel emerges as the leading supplier with the highest number of 'excellent' ratings, followed by TSM and GlobalFoundries. Although TSM has been a long-term supplier for Apple, it is getting pricey. Intel is as capable as TSM in production and supply chain and is eager to provide contract manufacturing service and thus has better pricing. GlobalFoundries and Texas Instruments are decent in production, with Texas Instruments possibly on the pricier side and GlobalFoundries offering more competitive prices. Finally, Qualcomm, AMD and Broadcom are excellent IC

TABLE 4 Summary scorecard

	INTC	*TSM*	*QCOM*	*GFS*	*AVGO*	*AMD*	*TXN*
Innovation, technological and engineering capability	Excellent (3)	Excellent (3)	Excellent (3)	Good (2)	Excellent (3)	Excellent (3)	Excellent (3)
Production and supply chain capability	Excellent (3)	Excellent (3)	Fair (1)	Fair (1)	Poor (0)	Poor (0)	Fair (1)
Pricing	Excellent (3)	Fair (1)	Fair (1)	Excellent (3)	Poor (0)	Excellent (3)	Poor (0)
Profitability	Fair (1)	Excellent (3)	Good (2)	Fair (1)	Excellent (3)	Fair (1)	Excellent (3)
Bargaining power	Excellent (3)	Poor (0)	Fair (1)	Excellent (3)	Good (2)	Good (2)	Good (2)
Financial health	Excellent (3)	Excellent (3)	Good (2)	Excellent (3)	Good (2)	Excellent (3)	Excellent (3)
Leaks and competition	Excellent (3)	Excellent (3)	Good (2)	Excellent (3)	Excellent (3)	Excellent (3)	Excellent (3)
Total score	**19**	**16**	**12**	**16**	**13**	**15**	**15**

Score calculation: Assuming equal weight for each criterion, excellent has a score 3, good 2, fair 1 and poor 0

designers but fall short in production capacity.

So what would be the sourcing strategy for CPU for Apple's iPhone? We suggest a dual-sourcing strategy: use Intel and TSM as the main CPU/IC suppliers, because Intel is clearly the best choice but changing critical suppliers involves significant work and risk in the transition. In comparison, TSM has been an excellent supplier for Apple with proven performance. Meanwhile, Apple can cultivate GlobalFoundries as a backup IC supplier and spread some work to Texas Instruments, AMD, Broadcom and Qualcomm for their specialities as minor suppliers. This strategy is similar to what Apple did in 2023, except 'Its most advanced silicon is primarily manufactured by one vendor, Taiwan Semiconductor Manufacturing Company'.[26] We think Apple should diversify its chip supply base to reduce risk and save costs in the long term.

CONCLUSION

This paper presents a sourcing analytics playbook for companies to effectively explore and select suppliers globally for critical components using analytics and publicly available data. We demonstrate the efficacy of the playbook by the example of CPU sourcing for Apple's iPhone. We conclude this paper by summarising the key steps of the playbook in Table 5.

TABLE 5 Sourcing analytics playbook for supplier selection

Steps	*Objective*	*Actions and methodologies*
1: Assess needs and define supplier selection criteria	Assess the company's sourcing needs and match the supplier selection criteria to the company's strategic objectives	**Industry analysis** to understand the industry potential and trend
		Competitive analysis to see where the company stands in the competitive landscape
		Breakdown analysis to identify major cost components, assess needs and set priorities
2: Identify potential suppliers	Identify potential suppliers by analysing the supplying industry	**Supply chain mapping** to visualise the supplying industry
		Business geographic information to identify regions with the strongest supplying industry
		Assess **market trends and concentration** to identify potential suppliers
3: Bargaining power analysis	Assess the leverage and negotiation power of the company and the suppliers	**Leverage assessment** to calculate the leverage of the company and the suppliers
		Bargaining power index to measure the relative negotiation power of the company and the suppliers
4: Supplier benchmark	Compare and select the best supplier(s) meeting the supplier selection criteria	**pricing and profitability analysis** to compare the pricing and profitability of the suppliers
		Financial health analysis to assess the short-term and long-term risks of the suppliers
		Assess the **production and supply chain capabilities** of the suppliers

Source: Authors

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APPENDIX

TABLE A1 Intel scorecard and explanation

Intel (INTC)	*Score*	*Explanation*
Innovation, technological and engineering capability	Excellent	Superior technology, innovative
Production and supply chain capability	Excellent	Strong production capacity, superior supply chain capability
Pricing	Excellent	Competitive pricing
Profitability	Fair	Less profitable in recent years
Bargaining power	Excellent	Intel is eager to make chips for others
Financial health	Excellent	Low risks, both short and long-term
Leaks and competition	Excellent	No similar products, not compete with Apple

TABLE A2 Taiwan Semiconductors Manufacturing Co. scorecard and explanation

Taiwan Semi. Mfg. (TSM)	*Score*	*Explanation*
Innovation, technological and engineering capability	Excellent	Superior technology
Production and supply chain capability	Excellent	Strong production capacity, strong supply chain capability
Pricing	Fair	Higher pricing
Profitability	Excellent	Highly profitable
Bargaining power	Poor	Increasingly powerful; Apple has no leverage
Financial health	Excellent	Low risks, both short and long-term
Leaks and competition	Excellent	No similar products, not compete with Apple

TABLE A3 Qualcomm scorecard and explanation

Qualcomm (QCOM)	*Score*	*Explanation*
Innovation, technological and engineering capability	Excellent	Superior technology
Production and supply chain capability	Fair	Limited production capacity, supply chain capability do not stand out
Pricing	Fair	Higher pricing
Profitability	Good	Quite profitable
Bargaining power	Fair	Apple has some leverage
Financial health	Good	Healthy in the short-term, some long-term risk in the past but improved
Leaks and competition	Good	Some lawsuits on patents, potential leaks

TABLE A4 GlobalFoundries scorecard and explanation

GlobalFoundries Inc. (GFS)	*Score*	*Explanation*
Innovation, technological & engineering capabilitand	Good	Technologically capable
Production and supply chain capability	Fair	Strong production capacity, but much smaller than INTC and TSM
Pricing	Excellent	Competitive pricing
Profitability	Good	Broke even in 2022 for the first time after a long time of losses
Bargaining power	Excellent	Apple has the bargaining power
Financial health	Excellent	Low risks, both short and long-term
Leaks and competition	Excellent	No similar products, not compete with Apple

TABLE A5 Broadcom scorecard and explanation

Broadcom (AVGO)	*Score*	*Explanation*
Innovation, technological and engineering capability	Excellent	Superior technology
Production and supply chain capability	Poor	Insufficient production capability for itself. Supply chain capability does not stand out
Pricing	Poor	Highest pricing
Profitability	Excellent	Quite profitable
Bargaining power	Good	Apple has some leverage
Financial health	Good	Low short-term risk, high long-term debts
Leaks and competition	Excellent	No similar products, not compete with Apple

TABLE A6 Advanced Micro Devices scorecard and explanation

Adv. Micro Devices (AMD)	*Score*	*Explanation*
Innovation, technological and engineering capability	Excellent	Superior technology
Production and supply chain capability	Poor	Insufficient production capability for itself. Supply chain capability does not stand out
Pricing	Excellent	Competitive pricing
Profitability	Fair	Less profitable
Bargaining power	Good	Apple has some leverage
Financial health	Excellent	Low risks, both short and long-term
Leaks and competition	Excellent	No similar products, not compete with Apple

TABLE A7 Texas Instruments scorecard and explanation

Texas Instruments (TXN)	*Score*	*Explanation*
Innovation, technological and engineering capability	Excellent	Superior technology
Production and supply chain capability	Fair	Strong production capacity, but much smaller than INTC and TSM
Pricing	Poor	Highest pricing
Profitability	Excellent	Highly profitable
Bargaining power	Good	Apple has some leverage
Financial health	Excellent	Low risks, both short and long-term
Leaks and competition	Excellent	No similar products, not compete with Apple