A Work Project, presented as part of the requirements for the Award of a Master's degree in Master's in Management/Finance from the Nova School of Business and Economics.

Broadcom's failed acquisition of Qualcomm

Offer Analysis and Company Valuation

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20-12-2023

Abstract

In November 2017, Broadcom made an initial bid to take over its competitor Qualcomm, a US based semiconductor company, to create one of the largest technology enterprises worldwide in a deal that raised concerns about regulatory approval right from the start. The case examines the situation at the beginning of March 2018 after Broadcom had already made two revised bids and analyzes different angles to give a comprehensive overview of the acquisition. This part of the case study focuses on the valuation of Qualcomm by using multiple approaches to calculate share prices, enterprise, and equity values. Further, it analyzes the different components of the offers made to the target shareholders by highlighting the benefits and shortcomings of the stock and cash payment. Lastly, it discusses the fit of the valuation methodologies taking into consideration the varying business models and approaches.

Keywords

Corporate Finance, M&A, Valuation, DCF, DDM, Comparables

This work used infrastructure and resources funded by Fundação para a Ciência e a Tecnologia (UID/ECO/00124/2013, UID/ECO/00124/2019 and Social Sciences DataLab, Project 22209), POR Lisboa (LISBOA-01-0145-FEDER-007722 and Social Sciences DataLab, Project 22209) and POR Norte (Social Sciences DataLab, Project 22209).

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List of Abbreviations

AI	Artificial Intelligence	IP	Intellectual Property
CAGR	Compound Annual Growth Rate	LTE	Long Term Evolution
CCA	Comparable Company Analysis	LTM	Last Twelve Months
CDMA	Code-division multiple access	NAFTA	North American Free Trade Agreement
CFIUS	Committee on Foreign Investment in the United States	NFC	Near Field Communication
CPU	Central Processing Unit	OFDMA	Orthogonal Frequency-Division Multiple Access
CTA	Comparable Transaction Analysis	OSAT	Outsourced Semiconductor Assembly and Test
D&A	Depreciation & Amortization	OWC	Operating Working Capital
DCF	Discounted Cash Flow	P&L	Profit & Loss
DDM	Dividend Discount Model	QCT	Qualcomm CDMA Technologies
DOJ	Department of Justice	QSI	Qualcomm Strategic Investments
DSL	Digital Subscriber Line	QTL	Qualcomm Technology Licensing
Fabs	Fabrication facilities	R&D	Research & development
FCF	Free Cash Flow	SG&A	Selling, General & Administration
FINSA	Foreign Investment and National Security Act	SIA	Semiconductor Industry Association
FTC	Federal Trade Commission	SME	Semiconductor Manufacturing Equipment
Gbps	Gigabit per second	SSD	solid-state drive
GDP	Gross domestic product	TSMC	Taiwan Semiconductor Manufacturing Company
GPS	Global Positioning System	TWC	Trade Working Capital
GPU	Graphics Processing Unit	USTR	United States Trade Representative
HHI	Herfindahl Hirschman Index	WACC	Weighted average cost of capital
IoT	Internet of Things		

Case

1. Introduction

It was a wonderful morning on March 4th, 2018, and Paul Jacobs, Chairman of Qualcomm Incorporated ("Qualcomm"), had just arrived in his office in San Diego, the HQ of Qualcomm. The past few months had been exceptionally demanding and he was looking forward to a quieter day at work when he started checking his email. Suddenly, he froze. He couldn't believe what he had just read. It was an order from a US government agency to review the takeover bid made earlier by Broadcom Limited ("Broadcom"), citing national security concerns. About four months ago, on November 6th, 2017, Broadcom, one of his firm's main competitors, had made an unsolicited takeover bid of $103 billion, which would lead to the largest acquisition in the technology sector to date, ultimately creating a company with a market capitalization of more than $200 billion.

All the work he and the other executives had put into the process of validating and discussing the initial and adjusted offers made by Broadcom was about to be in vain. For days and weeks, Paul and the Board of Directors had sat together with internal and external advisors to discuss the financial and, especially, the regulatory viability of the potential takeover and the implications for the company, its shareholders, and its employees. They had received a total of three offers, all of them consisting of a cash and a stock component. These offers came at a time were Qualcomm itself was trying to acquire another semiconductor company, NXP Semiconductors N.V. ("NXP") and where Apple, one of its main customers, had just sued them for alleged overcharging. Additionally, the FTC had started to sue Qualcomm for anti-competitive practices. While the first offer was valid regardless of the success of this transaction, the two following ones would have their validity tied to certain conditions regarding the acquisition and other requirements, thus creating even more pressure and tension.

Although shocked by the order of the US government, he immediately started to act by postponing the 2018 annual shareholder meeting, originally scheduled for March 6th, back to April 5th.

2. Chip Industry

2.1. Cross-market relevance

The Silicon Valley is named after the chemical element that is the most important component of microchips and the core of the US technological industry. These days, the majority of attention the Valley gets is directed at companies like Apple, Facebook, and Google, which are better known for their high-end user devices and services rather than for the CPUs that run them. But in the 1950s and 60s, technological advances including the integrated circuit and the transistor, created in Silicon Valley, helped turn computers from unstable room-sized machines into reliable pocket-sized devices (Hitachi 2019). This enabled today's titans of technology to thrive. These days, everything from fighter jets to automobiles and washing machines is being powered microchips.

The worldwide semiconductor market has been expanding reasonably consistently over the past 25 years, reaching 6.9% on average (Deutsche Bank Research 2023). Growth after 2010 has not been as noteworthy, although it has mainly stayed in the range of 0% and 10%. Today in 2018, a dearth of supply led to higher pricing, which in turn caused a 22.2 % year-over-year increase. The observed development pattern is indicative of the increasing reliance on semiconductor technology in many industries (IMF 2018).

The capital markets have acknowledged the financial well-being and future prospects of the semiconductor sector, as seen by the strong shareholder returns achieved by semiconductor businesses. These returns have exhibited an average annual growth rate of 25% between 2013 and 2017, compared to 9% of overall market (Deutsche Bank Research 2023).

2.2. Understanding the Semiconductor industry

The semiconductor business is made up of several diverse divisions, including memory, logic, analog, discrete, optical components, and sensors. Certain markets are often the focus of individual semiconductor businesses and their manufacturing facilities. Contrarily, their end users usually need goods from every semiconductor category and hence depend on a number of suppliers. Even when all other components are accessible, the production of finished goods may come to a complete stop due to the lack of a single specialized chip.

People often underestimate how intricate and multifaceted the producing process is. The process encompasses all stages of production, from material procurement to back-end manufacturing. In this process, businesses often specialize in three or fewer phases for each product category, and contract out certain tasks to external partners (Appendix 2).

In several of these value chain areas, the industry has gotten more concentrated over the past 20 years, and a few leaders have developed in each. As a result, knowledge is frequently concentrated in particular markets (for example, the United States has the biggest concentration of equipment production and fabless players, which focus solely on chip design) (John Ward 2023). The skill concentration has produced a web of interdependencies along the value chain, and no local market possesses all the capabilities necessary for end-to-end semiconductor design and manufacture (Appendix 3).

2.3. Market Structure

Several companies work together to create a "semiconductor ecosystem" since semiconductors require an array of complex technologies (Appendix 4). Before being released onto the market, semiconductors must go through the designing, production, assembly, and quality control stages.

Types of players

There are six distinct types of semiconductor businesses among corporations. Integrated Device Manufacturer (IDM), IP Company (chipless), Fabless, Design House, Foundry and OSAT. Explaining the most important one's (Samsung Semiconductor Global 2023):

Integrated Device Manufacturer (IDM) describe companies that manage every step of the semiconductor manufacturing process. That indicates that a single company owns the fab (fabrication facility), the wafer-producing facility, and is also in charge of wafer processing, testing, packaging, and semiconductor design.

IP businesses handle specifically the design of semiconductors. IP firms gain licensing fees or royalties on the usage of their designs when they supply a fabless, IDM, or foundry with specific designs, referred to as a "cell library." They are known as "intellectual property" companies for this reason.

A fabless corporation specializes in designing semiconductors. Everything is outsourced, including packaging, testing, and wafer fabrication, aside from design. However, the fabless owns the ownership and commercial rights to the chips that are produced by the contracted businesses. As a result, it markets products under its own name. A fabless business model allows for the design of semiconductors without the need for large, capital-intensive factories. With no facilities for manufacturing semiconductors, they concentrate on creating innovative concepts and creating semiconductor chips using the greatest technologies available for chip design. Therefore, businesses that maintain technological diversity and create a wide range of goods in small quantities are typically fabless.

Market competition

The semiconductor industry most closely resembles an oligopoly among the four main market structures in economics: perfect competition, monopoly, oligopoly, and monopolistic

competition. However, because certain companies rely on product differentiation to preserve market power, there are some aspects of monopolistic competition in the semiconductor sector.

The semiconductor business has an oligopolistic market structure due to its small number of companies and distinctive features. New businesses are discouraged from entering the market by rapid product cycles and low returns, even though all businesses must incur significant capital expenditure.

According to the LTM revenues of the top semiconductor companies worldwide, Intel and Samsung are making $61 billion apiece, leading the sector, followed by SK Hynix ($24 billion), Qualcomm ($23 billion), Micron ($21 billion), Broadcom ($19 billion), Texas Instruments ($15 billion), and NXP ($9 billion).

The merger of Broadcom, Qualcomm, and NXP would heighten the oligopolistic rivalry, including three dominant firms and a significant disparity between their smaller competitors.

2.4. Relevance of M&A in semiconductor industry

Continuous innovation is essential for businesses in high-technology industries to flourish because of the intense rivalry in these sectors. Today, more than 20% of semiconductor businesses' sales go into R&D expenditures to keep up with competition. Therefore, a company's ability to innovate can even determine whether it survives. For example, in the 1980s, American semiconductor businesses were forced out of the semiconductor memory industry by the faster advancements made by Japanese rivals. Technology is transforming the competitive scene even faster in the twenty-first century, resulting in high numbers of M&A activity. Businesses are more and more forced to engage in mergers and acquisitions in order to progress their technological know-how due to the intense rivalry in the high-tech industry. The rapid evolution of technology makes it increasingly difficult to predict the status of the industry in a few years. In an effort to lower risk and prepare for the future, high-tech companies are

buying businesses they think could be the next great thing. The short product life cycle in the semiconductor sector is another factor contributing to the rise in M&A. The semiconductor memory chip cycle "begins in a growth regime characterized by increasing demand, and switches stochastically to a decaying regime, in which demand generally falls," (Bollen 2009). For a certain type of memory chip, it only takes around three to four years to achieve its peak sales, after which there is a sharp decline in demand. To maintain the semiconductor company's viability, a new product is released prior to the peak of memory chip demand. Sales of each memory chip show a bell-shaped pattern that overlaps with the bell forms of the items that came after. The product life cycle to product development time ratio in semiconductors is a third for cars and half for mobile phones. Memory chip development takes around 16.6 months from start to finish (MSCI 2023).

2.5. Strategic Importance of the semiconductor industry

In today's technology laden world, semiconductors are integral components in a wide range of products: From cars and consumer electronics to infrastructure and defense systems. Different kinds of chips run our phones, washing machines and much more. This ubiquity in all facets of society, both in private life as well as the military sector, places the semiconductor industry at the heart of the global economy, turning the market into a highly competitive battleground. Especially the United States (US) and China, recognizing the strategic importance of this technology sector, are intensely striving to achieve supremacy, exemplified by extensive government support for chip companies in both countries (Ito 2023).

Currently the semiconductor supply chain is highly globalized, involving a complex network of companies and resulting in multiple bottlenecks. The most advanced chips are designed in the US using software exclusively provided by US based firms. Additionally, the US and UK together account for 90% of core IP in this field. When it comes to manufacturing, China holds a strong supply of raw materials, particularly in low-grade gallium, tungsten, and magnesium

while European companies occupy a critical space in the supply of chemicals. Fabrication facilities (fabs) require the highest specialization and sensitivity equipment of any production process in the world, with print sizes measured in atoms. This makes semiconductor manufacturing equipment (SME) expensive and extremely difficult to produce. Together only three countries - Japan, the Netherlands, and the US - dominate the global supply of SME, while China produces less than 2% of the supply (Thadani and Allen 2023). All the worlds most advanced fabs are located in Taiwan and South Korea, with them holding 92% and 8% of capacity respectively (Varas et al. 2021).

This interconnectedness of the semiconductor supply chain directly influences national interests and security concerns, exemplified by the US-China trade war. Starting in 2018, the Trump administration placed tariffs on Chinese products and tried restricting transfers of US technology to China, particularly in the telecommunications sector (Swanson 2018). Despite facing significant challenges, such as US export controls and international competition, China has made notable strides in the semiconductor industry, for example increasing national production capabilities for SME. Reducing reliance on foreign, particularly US, semiconductor technology is a top priority, driven by significant investments in domestic semiconductor production and efforts to acquire technology from international sources (Yin Li & Kaidong Feng 2022).

3. Qualcomm’s business model

Qualcomm is a leading fabless designer, developer, and global supplier of a wide array of digital and analog semiconductor solutions. Qualcomm's comprehensive product portfolio caters to several primary end markets. These include mobile devices, automotive, computing, and Internet of Things (IoT). Qualcomm specializes in mobile technology, particularly in wireless communications and mobile processing. Their product portfolio includes mobile components

(e.g. radio frequency components, processors and modem chips including its Snapdragon series), wireless communication technology (e.g. CDMA, LTE, Wi-Fi, GPS and upcoming 5G technology) and automotive solutions (e.g. in-car connectivity components and infotainment systems). Additionally, Qualcomm's developments in 3G, 4G, and 5G technologies play a crucial role in telecommunications infrastructure, including base stations and networking equipment. The company outsources production to various third-party semiconductor foundries including TSMC and Samsung Electronics to avoid large capital investments in own fabrication facilities (Qualcomm 2017).

3.1. Company history

Throughout its history, Qualcomm has been a key player in the telecommunications and semiconductor industries, known for its technological innovations and significant contributions to wireless communications. Qualcomm was founded in 1985 by seven industry veterans, including Dr. Irwin M. Jacobs and Dr. Andrew Viterbi, in San Diego, California. Initially, the company focused on contract research and development services, but it soon pivoted to developing its own telecommunications technologies. In 1989, Qualcomm introduced Code Division Multiple Access (CDMA) technology, a major breakthrough in mobile communications that increased the capacity and quality of cellular networks. Throughout the 1990s, Qualcomm rapidly grew as CDMA technology was adopted by major telecommunications networks worldwide. This period saw significant advancements in CDMA and the introduction of the first CDMA-based cellular phones such as the Motorola StarTAC, launched in 1996. Qualcomm capitalized on this momentum and started licensing its CDMA patents to other mobile manufacturers, which became a major revenue source (Mock 2015). In the 2000s, Qualcomm continued to innovate, develop and enhance wireless technologies, including the evolution of CDMA into 3G technologies. The company also expanded its reach into semiconductor manufacturing through the development of mobile processors and modem

chips under the Snapdragon brand. These chipsets became widely used in smartphones and mobile devices due to their high performance and energy efficiency. The smartphone era of the 2010s further strengthened Qualcomm's position in the market. Snapdragon processors became synonymous with high-end smartphones, and Qualcomm's modem chips were crucial for 4G LTE networks. However, this period was also marked by legal challenges as Qualcomm faced various antitrust investigations and lawsuits over its patent licensing practices, including disputes with major customers like Apple (Walker 2020).

3.2. Core Business Operations

Qualcomm operates a dynamic business model that intricately blends its core operations in semiconductor manufacturing with strategic intellectual property licensing.

At the core of Qualcomm's operations lies its Qualcomm CDMA Technologies (QCT) business, primarily driven by the renowned Snapdragon series chipsets, such as the Snapdragon 835 and 845 models. These chipsets, crucial in powering a diverse array of mobile devices like the Samsung Galaxy S8 and Google's Daydream VR, range from budget-friendly options like the Snapdragon 450 to the high-end Snapdragon 835. They are known for their superior processing power and energy efficiency and are therefore part of most smartphones in the market. Each chipset in the series is designed to deliver optimal performance, connectivity, and battery life, catering to specific needs across various market segments. Qualcomm's semiconductor division, further, is celebrated for its high-performance processors and modem chips, like the X16 LTE modem which offered groundbreaking download speeds of up to one gigabit per second. These innovations in processor and modem technology are key drivers in propelling the mobile technology industry forward, enabling advancements in areas such as 5G connectivity and AI integration in mobile devices (Qualcomm 2017).

The second pillar of Qualcomm's business model is its high-margin Qualcomm Technology Licensing (QTL) division, which manages an extensive patent portfolio of over 130,000 issued patents and patent applications globally, covering essential aspects of 3G, 4G, and emerging 5G wireless communications. This vast collection of intellectual property enables Qualcomm to secure licensing fees, a notable part of its revenue stream, from a wide array of smartphone manufacturers and other device makers globally (Qualcomm 2017). Qualcomm's licensing practices with its controversial strategy of charging a percentage of the total selling price of each mobile device (up to 5% in some cases) as a royalty for its patented technologies instead of charging a fixed price which is common industry practice have attracted intense regulatory scrutiny. This includes a protracted legal battle with Apple over the fairness and legality of such fees (Jansen 2019).

The interlinkage between QCT and QTL is intrinsic to Qualcomm’s overall strategy and success. The cutting-edge chipsets developed and produced by QCT often incorporate technologies that are patented by Qualcomm and managed by QTL. This means that the innovations and advancements achieved by QCT can lead to new patents, subsequently managed and monetized by QTL. In essence, QCT's technological advancements fuel QTL's patent portfolio, and QTL's licensing agreements. This widespread adoption of Qualcomm's technology standards, facilitated by QTL, creates a broader market presence for these technologies, which, in turn, increases the demand for QCT's products that are built on these standards. This synergy ensures that Qualcomm not only leads in semiconductor technology innovation but also benefits from the widespread adoption of its patented technologies across the industry. Thus, research and development efforts are also a cornerstone of Qualcomm's strategy. The company’s dedication to innovation is reflected in its significant R&D expenditure, which amounted to approximately $5.5 billion in 2017 which accounts for about

25% of its total revenue. This investment is key to maintaining Qualcomm's edge in rapidly advancing technologies, especially in the development of 5G (Zimmermann 2023).

3.3. Revenue streams

Qualcomm's financial structure is heavily anchored in two principal revenue streams: its licensing business through the QTL division and its semiconductor sales via the QCT segment. In the fiscal year 2017, Qualcomm's total revenues reached $22.3 billion, with these two segments contributing the most. The QTL division, responsible for monetizing the company's extensive patent portfolio in wireless technology, contributed significantly, accounting for about $6.4 billion or 28% of the total revenue. This segment, despite its smaller size compared to the QCT division, stands out for its remarkably higher profit margins, attributed to the lower costs and high returns of licensing intellectual property. Nevertheless, there has been a significant decrease in revenues from the anterior year which is primarily attributed to withheld royalty payments from top customer Apple over allegations of unfair fee charges. On the other hand, the QCT segment, handling the more traditional but highly competitive and capital-intensive semiconductor business, constituted the bulk of the revenue with $16.5 billion or 74% but with comparatively lower profit margins. Due to reconciliating items the sum of the two exceeds 100%. The superior margins of the QTL division become even more evident when looking at the operating margins which declined from ~28% in fiscal year 2016 to ~17% in fiscal year 2017, driven by the increased share of revenue generated through the QCT segment (Qualcomm 2017).

The divergence in profitability between the two segments highlights the strategic value of Qualcomm's licensing business in its overall financial health. Qualcomm's ability to license its patents to smartphone manufacturers and other device makers is a cornerstone of its revenue model. The licensing agreements often require manufacturers to pay a royalty fee, which is a percentage of the selling price of the device of up to 5%. These fees are high-margin compared

to other revenue streams, such as direct product sales, contributing significantly to Qualcomm's profitability (Zimmermann 2017).

3.4. Market Positioning and Competitive Advantages

Qualcomm’s commanding position in the telecommunications industry is primarily anchored in its technological leadership in 3G and 4G wireless communication technologies. The company holds a substantial share of the global market for 3G/4G baseband processors, a testament to its dominance. This market leadership is further reinforced by Qualcomm's strategic and substantial investment in research and development which underpins its continuous drive for innovation and technological advancement. The fruits of this investment are evident in Qualcomm's extensive patent portfolio, which is one of the largest in the wireless industry, covering fundamental technologies in mobile communications. These patents include critical innovations in areas such as CDMA, Orthogonal Frequency-Division Multiple Access (OFDMA) and advanced 4G LTE technologies, which are foundational to modern mobile communication networks. It not only solidifies its position in existing 3G and 4G markets but also serves as a cornerstone for its foray into emerging 5G technology. Qualcomm's early and ongoing research in 5G positions the company at the forefront of the next generation of wireless technology. This includes key contributions to 5G standards and the development of the first commercial 5G modem chipset, the Snapdragon X50 (Qualcomm 2016). This emphasis on 5G is a strategic move to anticipate the technology's potential to revolutionize industries beyond mobile phones. The strength of Qualcomm’s patent portfolio thus serves as a formidable competitive moat. It not only fortifies the company's market position but also ensures a continuous stream of high-margin licensing revenues, underpinning its financial success and market dominance in the telecommunications sector (Zacks 2021).

3.5. Challenges and Risks

Qualcomm's business model, while robust, confronts inherent risks, particularly from its heavy reliance on licensing revenues. This segment's high profitability, with margins far exceeding those in product sales, underscores its significance. However, this reliance renders Qualcomm vulnerable to legal and regulatory headwinds. A notable instance is the legal dispute with Apple contesting Qualcomm's licensing fees. This contention is a significant aspect of a broader legal battle where Apple is accusing Qualcomm of charging exorbitant fees for the use of its patents. This dispute underscores a critical debate over Qualcomm's revenue model, particularly its practice of charging a percentage of the total device cost, rather than a fixed fee for each chipset used, which is a more common practice in the industry (Zimmermann 2023).

In parallel, the semiconductor market is experiencing aggressive competition, especially from Asian manufacturers. For instance, companies like Huawei and Samsung are not just expanding their market share but also boosting their R&D spending, with Samsung announcing a $151 billion investment in semiconductor R&D over the next decade (Li 2017). This rise in competition particularly affects Qualcomm in emerging markets, where its market share in smartphone chipsets faces challenges. In China, the world's largest smartphone market, local manufacturers like MediaTek and HiSilicon are making significant inroads, leveraging cost competitiveness and localized strategies. These dynamics necessitated strategic shifts from Qualcomm to sustain its leadership, especially in the face of the potential erosion of its market share in both the high-end and mid-range segments, where its global market share in “System on a Chip” smartphones stands at around 42% (Counterpart 2018).

3.6. The role of NXP

Besides the ongoing acquisition discussions with Broadcom, Qualcomm itself is currently in the process of acquiring NXP, a leading global semiconductor company operating primarily in the automotive, industrial & IoT, mobile, and communication infrastructure markets. NXP is

recognized for its expertise in high-performance mixed-signal products, which integrate analog and digital functions to process real-world signals such as sound, light and temperature. One of NXP's standout strengths lies in its robust presence in the automotive industry. The company is a key player in providing semiconductor solutions for automotive applications including advanced driver-assistance systems, automotive safety systems, powertrain and in-vehicle networking. The technologies are critical for the development of next-generation vehicles. This includes electric and autonomous cars (NXP 2018). In addition to its automotive expertise, NXP holds a strong position in the industrial & IoT sector. The company offers a range of solutions for smart, connected devices. Its products in this sector include microcontrollers, processors, and connectivity solutions. These are integral to the growing trend of industrial automation and the expansion of the Internet of Things including Wi-Fi, Bluetooth, Zigbee, and NFC (Near Field Communication) chips. Qualcomm's acquisition of NXP is driven by the goal of diversifying its product portfolio and geographic market presence. This move allows Qualcomm to expand into the automotive and IoT sectors, where NXP has established expertise with its advanced driver-assistance systems and safety technologies (Accenture 2017). The acquisition also reduces Qualcomm's reliance on the saturated smartphone market and positions the company to capitalize on the growing demand for connected and intelligent vehicles. In addition the company can expand opportunities in the IoT and industrial markets. Combining Qualcomm's mobile technology leadership with NXP's strengths in mixed-signal and automotive solutions, the acquisition aims to enhance innovation across these diverse sectors (MIPS 2018).

4. Broadcom’s business model

Broadcom is a leading fabless designer, developer and global supplier of a broad range of digital and analog semiconductor connectivity solutions. The company's extensive product range serves four primary end markets: wired infrastructure, wireless communications, enterprise

storage, and industrial & others. Their product portfolio includes networking hardware (e.g. network processors and controllers, fiber optic components and ethernet switches), broadband equipment (e.g. models, set-top boxes and cable modems), wireless components (e.g. radio frequency filters, amplifiers and front-end modules), storage and server solutions (e.g. Redundant Array of Independent Disks controllers, fiber channel host bus adapters) and industrial and automotive electronics (e.g. Wi-Fi and Bluetooth modules). Diversification in product offerings and strategic growth through major acquisitions are central to Broadcom's market strategy. The company outsources the production to various third-party semiconductor foundries including TSMC and Samsung Electronics to safe on significant capital investments in own foundries (Broadcom 2017).

4.1. Company history

Throughout its history, Broadcom has transformed from a modest semiconductor company into a global industry leader, known for its diverse product range and strategic growth through acquisitions. Initially, HP decided to spin off its semiconductor products division, which became Agilent Technologies in 1999, followed by the acquisition by Silver Lake Partners and KKR in 2005 which led to the formation of Avago Technologies. The company started as a designer of semiconductors for broadband communications and rapidly gained recognition for its innovative products. Its early focus was on developing chips for cable modems, digital subscriber line (DSL), wireless networks, and networking equipment, which positioned it well during the internet boom of the late 1990s and early 2000s (ProQuest 2010). The company expanded its product lineup to include a broader range of communications chips, including those for Ethernet networking, Bluetooth, and Wi-Fi technologies. Avago Technologies made several strategic acquisitions, including LSI Corporation in 2013 and Emulex Corporation in 2015, significantly expanding its product portfolio and market footprint until its largest acquisition of Broadcom Corporation for $37 billion in 2016. Following this acquisition, the

combined entity was renamed Broadcom Limited, capitalizing on the Broadcom brand's strong market presence (Broadcom 2018). This transformative acquisition greatly enhanced its wireless communications and broadband portfolio and substantially increased its market presence. In 2017, Broadcom completed the acquisition of Brocade Communications Systems, a network solutions provider, for approximately $5.9 billion, enhancing Broadcom's position in the storage area networking space. The acquisition of Qualcomm including NXP could be the next transformational acquisition in the context of its acquisition history (Appendix 5).

4.2. Core Business Operations

Broadcom’s core business operations revolve around the design, development, and supply of an extensive range of semiconductor devices. The company's product portfolio is diverse and multifaceted, addressing several crucial areas in the tech industry. In data center networking, Broadcom stands out with its high-performance switches and routers, which are essential in managing the data flow in large-scale internet services and cloud computing infrastructures. These products are known for their reliability, speed, and efficiency, making them preferred choices in corporate and cloud data centers. For home connectivity, Broadcom offers innovative Wi-Fi and Bluetooth chips that are integral to a multitude of consumer electronics, ranging from personal devices to smart home systems. These chips are designed for high-speed data transmission, low power consumption, and robust connectivity, meeting the demands of modern wireless communication. In the broadband access market, Broadcom’s products include advanced DSL and cable modems, enabling high-speed internet connectivity in both residential and commercial settings. These modems are known for their stability, compatibility with various network standards, and ability to handle high bandwidth requirements. The telecommunications sector sees Broadcom’s significant contribution with its baseband processors and radio frequency front-end modules. These components are critical in the functioning of smartphones and base stations, facilitating effective communication and data

transmission. Broadcom’s products in this segment are recognized for their performance, supporting advanced features like high-speed mobile data and enhanced signal reception (Broadcom 2018).

A key strategy in Broadcom’s business model is its aggressive pursuit of growth through mergers and acquisitions, allowing it to expand its market reach and diversify its product offerings. A prime example of this strategy is the acquisition of Broadcom Corporation for $37 billion followed by renaming the merged company to Broadcom. This acquisition notably enhanced Broadcom’s capabilities in wireless communications and broadband technology, adding depth to its product portfolio. These strategic acquisitions not only broaden Broadcom's range of products but also reinforce its position as a comprehensive solutions provider, solidifying its status as a formidable force in the global semiconductor market. This approach has enabled Broadcom to stay ahead in a competitive industry, continually adapting and expanding its technological offerings (Seeking Alpha 2018).

4.3. Revenue Streams

In the fiscal year 2017, Broadcom's diversified revenue streams contributed to a total revenue of approximately $17.6 billion, showcasing the company's broad market reach and strategic risk mitigation. As a key segment, wired infrastructure contributed a significant portion of Broadcom's total revenue of $8.5 billion or 48%. This segment, which includes products for data center networking, server storage, Ethernet switches, and more, benefits from the global expansion in cloud computing and data center infrastructure on the back of increasing demands of cloud computing, data center expansion, and the global adoption of high-speed networking solutions. Wireless communications as another major revenue driver includes RF components, Wi-Fi, Bluetooth, and GPS technologies used in various wireless devices, including smartphones, and contributed $5.4 billion or 31% of revenue driven by the widespread adoption of smartphones and the ongoing advancement in mobile technologies. Enterprise Storage,

comprising server storage, controllers, adapters, and Integrated Circuits contributed $2.8 billion or 16% of revenue, while Industrial & other include a range of products for automotive, industrial, and various other applications, contributing $0.9 billion or 5% of revenue. This multifaceted approach to revenue generation not only highlights Broadcom's capacity to address various market needs but also demonstrates its strategic positioning to reduce reliance on any single market segment. By spreading its financial interests across multiple technology sectors, Broadcom effectively navigates market fluctuations and sector-specific challenges, ensuring a stable and robust financial profile in the dynamic tech landscape (Broadcom 2018).

4.4. Market Positioning and Competitive Advantages

Broadcom's strong market position across various sectors is underpinned by its extensive product range and strategic integration of acquired technologies, which have been key to its sustained leadership and growth in the industry.

In the wired infrastructure sector, Broadcom excels with products essential for the backbone of internet and data services, such as high-performance switches and routers. These products are crucial in managing data flow within networks, supporting the infrastructure of vast internet services and cloud computing. Broadcom’s command in this market is bolstered by its deployment of cutting-edge technology in wired networking. Broadcom’s presence in wireless communications is marked by its advanced radio frequency components and baseband processors. These components are critical for mobile devices and telecommunications equipment, ensuring efficient data transmission and signal processing. Broadcom's market advantage in this sector stems from its ability to provide components that are integral to the functionality of a wide range of wireless communication devices. In enterprise storage, Broadcom offers a variety of products including controllers and adapters that are key to data center servers and storage systems. These products facilitate efficient data storage and retrieval, an essential aspect of modern IT infrastructure. Broadcom’s leadership in this market is a result

of its focus on high-performance storage solutions that cater to the growing data needs of businesses. Broadcom also extends its reach to the industrial sector, providing components for applications in automation, power generation, and alternative energy systems. Its products in this sector are designed to meet the specific demands of industrial applications, ensuring reliability and efficiency in environments that often require precise and robust components (Broadcom 2017).

Besides Broadcom's diverse and innovative product portfolio, which gives the company its competitive edge, its strategic approach to research and development contrasts with typical industry practices. Rather than heavily investing in R&D, Broadcom's strategy, particularly under CEO Hock Tan, has been to streamline R&D expenses, focusing on areas with the highest return on investment. This approach involves carefully selecting projects that align with the company's core business and growth objectives, ensuring effective utilization of resources. This strategy, while potentially limiting in terms of broad-spectrum innovation, has been critical in maintaining profitability and focusing on the most commercially viable technological advancements (Pitchgrade 2018).

4.5. Challenges and Risks

Despite its strengths, Broadcom's business model faces challenges. The company's aggressive acquisition strategy, while beneficial in expanding its market presence, also brings integration risks and potential regulatory hurdles. Additionally, the semiconductor industry's highly competitive nature requires constant innovation and adaptation. Broadcom's ability to keep pace with rapid technological changes and emerging market trends is critical for its continued success. One major risk associated with this acquisition-driven strategy is the integration of different corporate cultures and systems. Each acquisition brings its own set of operational methodologies and corporate cultures, which can lead to challenges in harmonizing these diverse elements within a single corporate entity. Successfully merging these different entities

requires careful management to avoid operational inefficiencies and potential conflicts that can arise from differing corporate philosophies and practices. Additionally, Broadcom's large-scale acquisitions often attract intense scrutiny from regulatory bodies. These regulatory challenges stem from concerns about market monopolization and antitrust issues. Ensuring compliance with various international trade and antitrust laws becomes increasingly complex as the company expands its global footprint through acquisitions. Navigating this regulatory landscape is crucial for Broadcom to avoid legal complications and potential penalties, which can impact both its financial standing and market reputation. In the highly competitive semiconductor industry, innovation and technological advancement are essential for maintaining market leadership. Broadcom faces the ongoing challenge of keeping pace with rapid technological changes and evolving market demands. Key competitors such as Intel and Samsung in the industry are continually pushing the boundaries in areas like artificial intelligence, Internet of Things, and 5G technology (Gupta 2018).

4.6. Strategy behind Broadcom’s acquisition history

Broadcom, under the leadership of CEO Hock Tan and with significant influence from its largest shareholder, private equity firm Silver Lake Partners, is pursuing an aggressive and highly strategic acquisition-based growth model. This approach has been a defining characteristic of Broadcom's business strategy and has played a crucial role in transforming the company into a global semiconductor powerhouse.

CEO Hock Tan is known for his aggressive approach to mergers and acquisitions and has been pivotal in shaping Broadcom's growth strategy. Since taking over as CEO in 2006, Tan has led a series of strategic acquisitions which substantially increased the company's market presence and product portfolio. His approach typically involves acquiring companies with strong market positions and integrating their operations to achieve cost efficiencies and expanded market reach. Silver Lake Partners which is a major shareholder in Broadcom has played a significant

role in supporting and financing these acquisition strategies. The private equity firm's investment and backing have been instrumental in some of Broadcom's most significant acquisitions, providing the financial muscle such as the commitment letter for a $5 billion convertible debt financing in connection with the current Qualcomm acquisition and the strategic guidance necessary for these large-scale mergers (Reuters 2018).

Broadcom's acquisition strategy under Tan has been characterized by targeting companies that complement or enhance its existing product lines and market position. The goal has been to not only expand the company's footprint in the semiconductor industry but also to diversify its revenue streams and reduce dependency on any single market segment. Key acquisitions in Broadcom's history include the $37 billion acquisition of Broadcom Corporation, after which Avago Technologies rebranded itself as Broadcom. This acquisition significantly expanded its wireless communications portfolio. Further, the acquisition of Brocade Communications Systems in 2017 enhanced Broadcom's enterprise storage and networking capabilities. Each acquisition has allowed Broadcom to enter new markets or strengthen its position in existing ones, reducing risks associated with market volatility. By integrating operations, Broadcom aims to achieve cost efficiencies and economies of scale (PitchGrade 2018).

5. Broadcom's acquisition of Qualcomm

5.1. Strategic rationale and motives

Broadcom's ongoing attempt to acquire Qualcomm represents a strategic endeavor to form one of the world's preeminent semiconductor entities. Combined revenue would exceed $40 billion, based on 2017 figures – $22.3 billion from Qualcomm and $17.6 billion from Broadcom. By acquiring Qualcomm, Broadcom aims to significantly boost its footprint in the semiconductor industry, particularly in the mobile processing and telecommunications realms. Qualcomm's leadership in these areas, especially with its Snapdragon series in the smartphone market, offers

Broadcom a substantial expansion of its market reach. Broadcom, known for its broad array of semiconductor solutions, including components for wired infrastructure, wireless communications, and enterprise storage, would greatly diversify its portfolio with Qualcomm's mobile and telecommunications technologies, especially with Qualcomm’s modem leadership which would complete the wireless picture for Broadcom. Further, this strategic move is intended to further reduce Broadcom's market segment dependencies, making the company more resilient to sector-specific fluctuations (Reuters 2018).

The acquisition is expected to bring about significant operational synergies, while Broadcom’s track record of integrating acquisitions efficiently suggests potential cost savings in areas such as R&D, manufacturing, and marketing. Broadcom’s focus is to acquire companies that are a strategic fit for networking and communications which have a market leadership position or will enable Broadcom to have a leadership position with the acquisition while pushing out the competition. After the acquisition, Broadcom focuses on minimizing overhead through aggressive cost reductions, securing tighter relationships with the leading potential customers, and raising overall product Average Selling Prices (ASPs) to maximize return. Their R&D strategy tends to focus on maintaining the company’s position and to invest in low-risk markets where they can be competitive almost instantly on price and demand. This is a sound strategy that has allowed the company stock to perform well. The combined entity would likely leverage economies of scale and shared technological expertise to optimize production and innovation costs. The merger positions Broadcom to become a leader in the development of next-generation technologies like 5G. Qualcomm’s forefront position in 5G development and its vast patent library in wireless technology are seen as key assets that would give the combined company a competitive edge in shaping future telecommunications standards and technologies. However, mergers and acquisitions, on average, destroy rather than create shareholder value as the anticipated synergies often never materialize due to the blending of disparate corporate

cultures, high management turnover and a tendency to underestimate potential merger issues but if a firm can continue to successfully merge, acquire and integrate to its benefit, this can serve as a source of competitive advantage (CohnReznick 2022).

Further, the ambitious merger faces critical challenges, especially from regulatory and antitrust perspectives. The creation of such a dominant player in the semiconductor industry raises concerns about potential market monopolization. These concerns are particularly pronounced in markets where both companies have a significant presence. The U.S. government's scrutiny, citing national security concerns and the potential for stifling innovation and competition in the semiconductor sector, represents a significant obstacle to the merger's completion (Huddleston 2021).

CEO Hock Tan has been recognized for his assertive and strategic approach to growing Broadcom into a semiconductor industry leader. He immigrated to the United States from Malaysia and eventually became a naturalized citizen in 1990. Tan earned both bachelor's and master's degrees in mechanical engineering from MIT and subsequently furthered his education with an MBA from Harvard Business School. It was in 2006 that he became the CEO of Broadcom's predecessor Avago Technologies Ltd., which itself began as a division of Hewlett Packard. At the helm of Avago, Hock Tan has demonstrated remarkable expertise in deal making and value creation via acquisition. He targets businesses with high profit margins and then either significantly cuts or sells off the less successful parts of the business. Broadcom maintains a focus on its main customer bases of handset makers and data-center operators. After bringing chip makers LSI and Emulex into the Avago portfolio, Tan's crown jewel acquisition came about in 2015 when his company purchased the original Broadcom Corporation for $37 billion and renamed the merged company to Broadcom Limited. At the time of the merger, Broadcom Corporation's revenues were twice the size of Avago's. Post-acquisition, Tan's focus has typically been on streamlining operations to improve cost efficiency and profitability. This

has often involved restructuring and sometimes divesting non-core business units to focus on more profitable segments. “He ran through Broadcom with a machete.” says Stacy Rasgon of Bernstein Research and according to Linley Gwennap of the Linley Group, a consultancy focused on semiconductors, Mr. Tan eliminated an entire layer of management at Broadcom and now has around 20 business units reporting directly to him (Smoak 2018). Underpinning the strategy is a recognition that the semiconductor business has largely matured. The rate of revolutionary change has slowed, and chip companies have focused more on price competition, leading to lower profit margins. His approach has been to gain scale by buying market leaders and then running those companies more efficiently. Hock Tan has the backing of Broadcom’s majority shareholder, Silver Lake Partners, which has played a critical role in supporting and financing the company’s acquisition-led growth strategy. Silver Lake has provided significant financial support for Broadcom's acquisitions and has again provided Broadcom with a commitment letter for a $5 billion convertible debt financing in connection with the Qualcomm acquisition (Reuters 2018). The private equity firm’s role was instrumental in some of Broadcom’s major deals, including the financing required for the Broadcom Corporation acquisition. Beyond financial support, Silver Lake Partners has offered strategic guidance, aligning with Tan’s vision of expansion and consolidation in the semiconductor sector. Their involvement often indicates a focus on long-term value creation through operational efficiencies and market positioning. Silver Lake’s behavior as a shareholder suggests a balance between seeking aggressive growth opportunities and managing the associated risks, particularly in terms of regulatory and market challenges. Despite promises to continue Qualcomm’s focus on R&D investments, industry experts are questioning the compatibility and alignment of the companies’ current strategies given Hock Tan’s and Silver Lake Partners return driven approach typically focusing on cost cutting and increasing shareholder returns (Reuters 2017).

5.2. The development of the offers

On Monday, November 6th, 2017, Broadcom announced a proposal to acquire all outstanding shares of Qualcomm in a cash and stock deal that would value the latter at $70 per share and a total of $103 billion. The bid consisted of a cash component of $60 and an equivalent of $10 of Broadcom shares and presented a solid premium of almost 28% over the closing price on the last unaffected day of trading prior to the proposal's announcement. At the time of the proposal, Qualcomm itself was in the very act of acquiring NXP, a Dutch semiconductor designer and manufacturer headquartered in Eindhoven, Netherlands. In a statement issued by Broadcom, the proposal would stand whether the acquisition of NXP at $110 per share was to be successful or terminated (Broadcom 2017).

One week after the initial offer, on November 12th, 2017, the offer was rejected by the Board on the grounds of regulatory hurdles and undervaluation of the business (Qualcomm 2017a). Nonetheless, Broadcom proceeded with its plans and took the first formal move towards a hostile takeover bid by nominating 11 directors to replace the entire board of Qualcomm on December 4th, 2017, and taking the decision straight to the shareholders (Clark and de la Merced 2017). In January 2018, after Qualcomm had rejected the nominees the Federal Trade Commission started to investigate Broadcom's behavior and tactics to determine whether they engaged in anticompetitive action during negotiations with customers, which casted additional doubt on the regulatory approval for the deal.

On February 5th, Broadcom raised its initial offer by about 17% from $70 to $82 per share and called the offer its best and final one. With this offer the company was now valued at a total of $121 billion and the bid came one month before the annual shareholder meeting where Broadcom would try to replace the entire board. To underline the commitment to the merger, the offer even included a higher than usual breakup fee of $8 billion if the deal was to be stopped because of regulatory issues. The cash consideration per share was to continue at $60 while the

stock component would make up the remainder of the offered price, but the offer would only stand if the NXP transaction was to be completed at $110 per share or terminated and if the shareholder meeting scheduled for March 6th, 2018, would take place (Broadcom 2018a). Just 3 days later, on February 8th, Qualcomm rejected the offer once again but showed its willingness to find an agreement by proposing a meeting to discuss the proposal's shortages. Five days later, on February 13th, Broadcom agreed to cut down the number of seats on the Board from an initial 11 to just 6, following a meeting with ISS, a shareholder advisory firm providing its services to Qualcomm. This would still ensure a majority on Qualcomm's board. In an official statement issued by Broadcom, the offer of $82 per share would be contingent on the election of six Board members, ensuring a majority on the Board. Further, the offer was to be withdrawn after the determination of the 2018 results at the annual meeting, unless a definitive agreement would have been signed until then. One day later, on February 14th, representatives of both the acquirer and the target met for the first time to hold talks over a potential merger (Clark and de la Merced 2017).

About a week later, on February 20th, Qualcomm increased its bid for NXP from the initial $110 to $127.5 per share. This led to the acceptance of the offer but since Broadcom's offer for Qualcomm was only viable if the transaction would be successful at the initial price or not at all, this dealt a huge blow to the advanced talks between the two semiconductor companies and made Broadcom revised its offer for a second time and cut it to $79 per share valuing the target at $117 billion, on February 22nd. They also included a ticking fee of 6% p.a. on the cash component of the offer, starting 12 months after the signing until closing of the deal and invited Paul Jacobs and another Qualcomm director to join the combined company's board (Broadcom 2018b). Furthermore, between the end of February and the beginning of March, CFIUS began looking into Broadcom's plan to take over its competitor and amidst speculation that the merger would be stopped due to regulatory issues, Broadcom increased its efforts to redomicile into

the US and agreed on divesting several parts of the business. Nevertheless, this initiative came too late or wasn't sufficient, as the US government ordered national security to review the bid (Department of Treasury 2018).

6. Regulatory Environment

6.1. Status of US Foreign Trade policy in 2017/2018

Having gained office in 2017, the Trump administration marked a shift in the US stance on foreign trade. One of the defining factors was the so-called "America First" policy, which set to prioritize American interests and aimed to strengthen the US economy through various measures, including but not limited to tax cuts, national deregulation, a focus on domestic manufacturing and a trend to more protective international trade policy. Driven by the belief that previous administrations had allowed the US to be taken advantage of in global affairs, the policy also involved a reevaluation of international agreements and relationships. This included renegotiating the North American Free Trade Agreement (NAFTA) and engagements in trade disputes with several countries, most notably China (Swanson 2018). President Trump directed the Office of the United States Trade Representative (USTR) to investigate Chinese economic practices under Section 301 of the Trade Act of 1974. The resulting report raised concerns about intellectual property theft, trade imbalances, and the nature of China's industrial policies, allegedly costing the US economy in the hundreds of billions of dollars annually (Office of the U.S. Trade Representative 2018). Subsequently, Trump ordered tariffs on Chinese products and restrictions on Chinese investment in high tech sectors. These were intended to protect American industries and reduce trade deficits but led to tensions and raised concerns about a potential trade war. In response, China accused the US of nationalist protectionism and retaliated with their own trade restrictions on US products. The use of tariffs as a tool in trade

negotiations created uncertainties in the global market, affecting supply chains and international investments.

This shift in trade policy had a ripple effect on international relations. Traditional allies, such as Canada and European countries, expressed concerns over the tariffs, which they viewed as contrary to the principles of free trade. The use of Section 232 to impose tariffs on steel and aluminum imports was particularly contentious because it also affected close allies. Questions were raised about the use of national security as a justification for trade barriers (Solís 2017). Depending on political party lines, the "America First" agenda and the trade policy adjustments received differing responses domestically. Opponents voiced concerns about the potential of trade wars, the potential for negative effects on consumer prices, and the risk for allies to be alienated, whereas supporters countered that these steps were required to protect jobs and revitalize the American economy. The ongoing investigations into Russian meddling in the 2016 presidential election further polarized the political environment.

The semiconductor business garnered attention as US-China relations entered a period of elevated tension, primarily because of its vital role in the defense and modern technology sectors, in addition to the stability of supply chains. Fears of sabotage and espionage amid intensifying geopolitical conflicts contributed to this focus. Preserving technological prowess and safeguarding intellectual property remained top priorities. The Committee on Foreign Investment in the United States (CFIUS) became increasingly vigilant checking transactions, particularly but not limited to those involving Chinese entities, as part of broader measures to safeguard critical US technologies.

6.2. The role of the CFIUS in US trade policy

The US government's CFIUS is in charge of examining foreign investments in US businesses, especially when it comes to national security. The committee, which has the Secretary of the

Treasury as its chair, is made up of delegates from 16 departments and agencies, including Homeland Security, State, Defense, and Commerce. Established in 1975 under President Gerald Ford, the CFIUS was granted the power to block foreign investments in US companies with the Exon-Florio Amendment in 1988. This role was further expanded and strengthened by the Foreign Investment and National Security Act (FINSA) of 2007, which enhanced its oversight capabilities.

The CFIUS's primary functions encompass reviewing transactions involving foreign investments in US businesses that might impact national security. Examples include foreign entities gaining control of vital producers in the military sector or the protection of leadership in certain technology sectors. To this end, the committee conducts in-depth investigations of specific transactions that raise red flags. Depending on the findings of their investigations, the CFIUS might negotiate agreements to mitigate any identified national security risks, similar to antitrust regulators demanding divestures to greenlight a deal. In the end, the committee gives a recommendation to the president, advising the countries leader on whether the transaction on hand should be blocked or approved. This focus is especially pronounced in sectors involving critical technology, infrastructure, and data, with semiconductors being one of the key areas of interest (US DOT 2023).

CFIUS reviews can significantly influence foreign investments in US companies, often leading parties to preemptively modify deals to address potential security concerns. With the office of the president holding the power to terminate any merger and usually following CFIUS recommendations, non-compliance can quickly derail any hopes of deal completion. This makes the committee a potent tool in US foreign trade policy. However, the scope of investigations is limited to cross-border acquisitions and does not extend to national deals, even if they warrant concern.

In 2018, under the backdrop of rising geopolitical tensions and the protectionist economic strategy of the Trump administration, CFIUS's scrutiny intensified, particularly concerning investments in technology and critical infrastructure. Reviewing transactions that result in a US business being owned by a foreign entity or person, the proposed merger between Broadcom and Qualcomm in the semiconductor industry triggered an investigation to determine the effect of such a transaction. This heightened activity was in line with the administration's more stringent policy approach.

7. The road ahead

After taking the necessary steps to rearrange the annual meeting, Paul Jacobs sat down to look back at what had happened in the last weeks and started thinking about the company's prospect and the overall feasibility of the deal. Their 5G products were top of their class and Qualcomm could be a leader developing the next generation of telecommunication technology. On the other hand, the ongoing dispute with Apple and the associated withheld payments had already affected Qualcomm's revenues and profit margins significantly. The high uncertainty regarding the resolving was only surpassed by the vagueness of the deal proposed by Broadcom. Regulators had repeatedly signaled their concerns and while Broadcom was certain of the regulatory approval, Paul was not as confident. The ticking and reverse fee offered some additional security but would probably not cover all costs following a failed merger. His head was spinning as he pondered over and over again: Would the deal generate overall value? How might Qualcomm's business model change under new ownership? Were the shareholders going to agree to the proposed terms, including compensation and form of payment? What would be the markets reactions if a deal were to materialize? Would the regulators intervene in this deal or could their concerns be mitigated?

8. Individual Part – Kaspar von Both

8.1. Case Synopsis

In 2017, Broadcom made the first official bid to take over one of its main competitors, Qualcomm. Both companies are leading semiconductor companies with a well-diversified portfolio serving a variety of blue-chip customers globally. Broadcom had made several acquisitions in the past and Hock Tan, CEO of Broadcom was eager to create a market leading company in a deal that would be the largest deal in the semiconductor industry to date. The proposed transaction did cast doubts over the regulatory feasibility right from the beginning. After the first offer was rejected by Qualcomm, Broadcom went on to make two more, improved bids. In order to analyze the bids and the premium offered to Qualcomm shareholders, this case and its corresponding questions aim to derive a fair value of the target using different valuation methodologies, analyze the offer components and discuss the valuation in the light of the varying business models.

8.2. Learning Objectives

The case study offers students a profound insight into the different methodologies in hand to value companies. Since most transactions fail because of differing perceptions of the value of the target, it rarely happens that regulatory issues are the dealbreaker. The presented case study of the failed merger of Broadcom and Qualcomm therefore offers students a point of analysis that is often underrepresented in academic curriculums. Students are supposed to apply their knowledge of valuation methodologies and discuss the results, especially in comparison to the offers made by the acquirer, as well as the potential premium to current market prices. When analyzing the offers they are required to trade off the benefits against the shortcoming of different payment components.

8.3. Target audience

This case and its assigned questions are suitable for undergraduate, graduate, or MBA students who are pursuing a degree related to business, management, or finance. It can be taught in classes which address the topics of corporate valuation and strategy.

8.4. Teaching Plan

The case study can be taught in one lesson in any course related to the topics of corporate finance, especially corporate valuation, M&A, and strategy. Prior to the lesson, students are encouraged to read the case and prepare themselves accordingly by answering the assignment questions. Since the case study is based on true facts, students can do additional research about the companies and the case to stimulate a more practical approach. The assignment questions aim to inspire students to apply their knowledge of valuing companies, both based on internally generated cash flows as well as from a more market-centered perspective, interpreting the results and comparing the offers to trading stock prices to calculate the acquisition premium. In addition to the provided information in the group part, the professor can introduce initiate the in-class discussion by showing the video of Hock Tan announcing the redomiciling of Broadcom to the United States (Appendix 1).

8.5. Assignment Questions

8.5.1. What is the value of Qualcomm? Conduct a valuation for the target based on a DCF model, and include other approaches such as DDM, CTA & CCA. Afterwards, discuss the different approaches and the respective results.

There are multiple valuation methodologies that can be used to derive a company's value and this case study focusses on applying two approaches based on internally generated cash flows and two methods taking an external perspective (Appendix 11). It is important to deploy as many methods as possible since all of them have their respective benefits and shortcomings and

the entirety proves to lead to a comprehensive authoritative proxy for the adequate value of Qualcomm. The first approach is the DCF valuation.

Forecasting revenues, costs, capital needs and corresponding FCF's

The DCF model calculations are based on future cash flows which are the result of the business activity of the company going forward. Alongside the future profit and loss (P&L) statement, line items of both the balance sheet and the income statement must be forecasted to compute the future annual cash flows (Appendix 13).

Qualcomm's revenue stream can be subdivided into three different divisions, namely QCT, QTL, and QSI. In FY2013, Qualcomm had a fourth reportable segment, QWI, which was eliminated in the first quarter of FY2014 and has been included in "Reconciliation". Most of the revenue is generated through the QCT and QTL division, making up at least 97.5% of revenue for all years analyzed. The forecasting of those two segments is therefore most relevant to predict overall revenue in the future. For 2018, the global semiconductor market is predicted to grow at a rate of 4% followed by a decline of 1% in the year thereafter. In the long term, the market is going to grow at 2%, which also represents the growth rate of the years from 2020 onwards (Gartner 2019). Revenues of QCT have been forecasted accordingly. Sales from QTL are expected to continue to decline in FY2018 due to the ongoing lawsuit with top customer Apple over unfair, monopolistic behavior. The concern is projected to be resolved by the end of FY2019, leading to a return to the overall market growth trajectory of 2% in subsequent years. It is unclear whether Qualcomm will be able to convert their leadership in 5G technology into market leadership and above average revenue growth in the future. As stated in the annual report for 2017, commercialization of 5G technology is expected to commence in 2019 and might have a significant impact on the development of both revenue and R&D expenses. Due to the associated uncertainty, potential revenue effects were not included.

While the reported numbers of “SG&A” include depreciation and amortization, they have been isolated to derive a reasonable forecast. Although Qualcomm put in place a strategic realignment plan to lower the costs a significant reduction cannot be observed. As stated in the annual report of FY2017, all cost reduction initiatives were achieved in FY2016 and therefore must not be accounted for in the forecast. Since no additional cost reduction is to be expected, “Cost of revenue” and “SG&A” are assumed to be the average of the share of revenue of the past five years going forward. Costs for “Research and development” are forecasted as 25% of revenue until FY2019, when 5G is to be commercialized, stabilizing at 20% afterwards. Since D&A is not necessarily directly correlated with overall revenue, the forecast is linked to the assets that are subject to depreciation, namely tangible assets, and to amortization, intangibles. Further income and cost items are then categorized into “Non-operating items” and “Non-recurring items”. Income from interest and dividends has been forecasted at 2.5% of short and long-term investments, the average of the years FY2013 to FY2016. FY2017 has been excluded since Qualcomm divested a portion of its portfolio of marketable securities for the NXP acquisition. The interest expense can be forecasted at 2.4% of debt outstanding, based on the assumption that the cost of debt will remain constant at the level of past years excluding FY2013 and FY2014 since Qualcomm did not have significant debt during these years.

As Qualcomm is planning on putting more emphasis on the QSI division, “Impairment” is forecasted at a higher level than the one apparent in the past years analyzed. As mentioned earlier, the ongoing lawsuit with Apple and other regulatory disputes in multiple jurisdictions imposes a high threat of additional fines which is why they are expected to remain at a relatively high level of 5% of revenues in the coming years. The company’s effective tax rate is expected to be 17% representing a minor increase compared to the average of the rates observed from FY2013 to FY2017. Alongside the value drivers, working capital and Capex needs must be predicted, dividing the former into trade working capital (TWC) and operating working capital

(OWC) to derive a more accurate result. When looking at “Accounts receivable” a significant increase can be observed from FY2016 to FY2017, partly related to a new joint venture, but the majority stemming from the lawsuit with Apple and withheld payments. Since it is to be expected that the dispute is going to be resolved soon, leading to a normalization of receivables, the figure for FY2017 has been excluded for the forecasting of the item. The increase in “Inventory” is related to the joint venture and expected to continue to be relevant going forward. When developing the predictions for the OWC, “Short-term investments” need to be normalized, which has been done by averaging the percentage of revenues from the past four years and multiplying it with FY2017’s revenues. The normalization was made necessary by the already mentioned NXP acquisition, where in the forerun Qualcomm liquidated a substantial portion of its portfolio to finance the deal.

Looking at “Maintenance Capex” the cost reductions achieved in connection within the scope of strategic realignment appear to have generated an impact. Nevertheless, they seem to stabilize at 3%, which was assumed to be the value going forward. In all years analyzed, acquisitions have played a significant role, hence Capex for acquisitions must be considered as well. FY2015 has been excluded as the acquisition of CSR for a consideration of $2.3 billion led to an extraordinarily high value. After the forecasting of the value drivers, tax expenses must be subtracted. Further, D&A must be added back because of the non-cash-effective nature and cash-effective items like Capex and changes in NWC must be incorporated to derive FCF. The FCF in FY2018 is $6.9 billion, driven largely by the change in NWC and lower Capex compared to the anterior year. In FY2019 an FCF of ~$4.8 billion has been forecasted, a significant drop to FY2018 but rather a normalization after the excessively high value in the prior year. In the following, FCF increases from ~$5.4 billion in FY2020 to ~$5.5 billion in FY2022, driven by increased revenues and stable Capex and NWC. The terminal value is expected to be ~$118 billion based on the assumption of 2% growth which is the expected long-

term growth of the semiconductor industry and lower than the overall GDP growth and the WACC calculated in the following task, being 6.78%.

Deriving the Beta and cost of debt to calculate the WACC

The appropriate discount rate at which the future FCF are to be discounted is a combination of the firm-specific cost of debt and cost of equity, both weighed at their respective share in the overall financing structure. Since there are no real risk-free assets, yields of US Treasury bonds are commonly used as a proxy for the risk-free rate. The US Treasury Bond 9128283F5, issued in 2017, yielded 2.25% which has been used throughout the calculation of the WACC as the risk-free rate. The average market risk premium in the USA has been found to be 5.7% in 2017 (Social Science Research Network 2023). To calculate the Equity Beta, the daily closing prices and returns of Qualcomm's stock and the S&P500 have been analyzed in the year prior to the first offer, resulting in a Beta of 1.42, leading to a cost of equity of 10.37%.

The cost of debt can either be derived by analyzing Qualcomm's interest payments and the associated value of outstanding debt or using the credit. Due to inconsistent debt obligations and interest payments, the credit spread approach leads to a more reasonable result. In 2017, Qualcomm issued a 10-year bond, 747525AU7, which yielded 3.25% and implied a credit spread over the already mentioned US Treasury bond, regarded as risk-free rate, of 1pp. It is important to incorporate the tax rate (35%) since debt payments are tax deductible which ultimately lowers the actual cost of debt because of tax shields. The resulting effective cost of debt of 2.11% is accordingly lower than the yield on the corporate bond and even the risk-free rate and slightly above the average of debt payments made from FY2015 to FY2017. Combining the calculated figures, a WACC of 6.78% is received (Appendix 12).

Discount FCF to derive Qualcomm's value

To arrive at the correct valuation for the target, future cash flows must be discounted back to their present value to account for the time value of money. The two main variables that are necessary for discounting the FCF are the WACC and the time period factor with the latter being the adequate discount rate and the former incorporating the time lag. In the previous task the WACC was already calculated and amounts to 6.78% while the time period factor is dependent on the date of the valuation and the date of the annual statement of accounts. The first offer was made public on Monday, November 6th, 2017, but due to media speculation the last unaffected day of trading prior to the deal was November 2nd, 2017, which is why the valuation date has been chosen to be the same date as the last unaffected day. This also facilitates the comparison of the offer to the market value of Qualcomm since a potential acquisition premium must be calculated to an unaffected share price. The time period factor to the power of which future cash flows are discounted is calculated by dividing the days until the date of the annual statement of accounts by 360.

Discounting the individual FCF for each year, the sum of the very results equals Qualcomm's value, ~$109 billion. As we have forecasted cash flows to the overall firm and therefore to the entirety of providers of cash, both debt and equity holders, the result is Qualcomm's enterprise value, the sensitivity of which can be seen in Appendix 15. Further, the discount rate used is a combination of both the cost of debt as well as the cost of equity. To directly attain the equity value the DCF model would need to be adjusted slightly by adding the after-tax cost of financing to the FCF. Additionally, the discount rate to be used would be the cost of equity instead of WACC since the latter includes cost of debt.

To arrive at the equity value, net debt must be subtracted from the enterprise value, with net debt being the difference between the sum of debt outstanding and cash and cash equivalents,

excluding operating cash. Since Qualcomm had a significant amount of excess cash, net debt is negative at the valuation date (~$-10.9 billion), leading to the equity value being larger than the enterprise value (~$109 billion vs. ~$120 billion), driven largely by the terminal value, making up almost 79% of the enterprise value. The share price is obtained by dividing the equity value by the number of outstanding shares, ~1.5 billion at the date of valuation, leading to an implied share price of $81.07. Since the DCF values Qualcomm on a standalone basis going forward, it does not incorporate potential synergies. It can therefore be seen as the minimum price per share that Qualcomm shareholders should be offered per share. Under the assumption that the acquisition will lead to synergies the amount that Broadcom might be willing to pay and still leverage additional value exceeds the result of the DCF model.

Alternative approaches (DDM, CTA & CCA) and discussion of the results

In addition to the DCF another valuation method from an intrinsic point of view is the DDM. Moreover, a valuation can also be done from a market driven perspective: comparable company analysis, or CCA, and comparable transaction analysis, CTA. An overview can be seen in Appendix 11. Comparable companies and transactions should be as alike as possible, including factors such as industry, product mix, cost structure, size, geographical focus, and forms of financing. Relevant trading companies that have been included in the CCA are the main competitors like Intel, Samsung, SK Hynix, and NVIDIA. Based on multiples a proxy for the value of the company can be derived using the median instead of the average because of the lesser influence outliers have on it when compared to the average. The CTA serves two main purposes: showing relevant M&A activity in the market, indicating potential for higher multiples due to competition for acquisitions, and the other being a relevant estimate of multiples to be obtained in a deal. The potential deal between Qualcomm and Broadcom is hard to compare to other M&A activities because of the size of both companies. Even the largest deal in the recent past, the acquisition of ARM by SoftBank in 2016, sums up to a value of

approximately $32 billion which is less than one third of the Qualcomm deal. In general, multiples obtained by CTA are usually higher than those from CCA since full control is acquired and acquirers aim to leverage cost or revenue synergy potentials. The higher multiple is therefore driven by the control premium and synergies. This can also be observed in the data analyzed in this case study and therefore underlines the underlying theoretical reasoning.

When looking at both the multiples (Appendix 17) as well as the implied enterprise values (Appendix 18) a high dispersion in the results can be observed, which is one of the shortcomings of CTA and CCA valuation. Comparing the results obtained by multiplying the median multiples of the CCA with the relevant figures, Qualcomm should be valued at ca. $79 billion to $90 billion, which is significantly less than the number obtained by the DCF. The values obtained from CTA show a broader range ($74 to $218 billion). Both findings support the theoretical baseline that the DCF values the company on a standalone basis regardless of control premium or synergy potential, while those have probably influenced past transactions. Despite the large spread, they results can be combined to attain an estimate for the value of the company by equally weighting them, leading to an enterprise value of ~$109 billion, corresponding to a share price of $81.01, which is in line with the outcome of the DCF model.

Another method to derive Qualcomm's value is the DDM. Looking at the past years and the respective dividends, the payout ratio can be calculated. Based on the past payout ratio, future dividends have been computed until 2022. For the years following, the average growth rate of all years analyzed is assumed to be the future growth rate. The cost of equity has already been calculated during the calculation of the WACC and can be used as the discount rate, resulting in the current share price. In comparison to the value received by the DCF model, the result represents the equity value and after multiplying it by the number of outstanding shares, net debt must be added to derive the enterprise value. The calculations result in a share price of $75.43, implying an equity value of more than $111 billion, and a corresponding enterprise

value of about $100 billion. The DDM relies on very strong assumptions, e.g., the payment of dividends depending solely on the payout rate and payouts are directly, positively correlated with revenue. An example of additional factors influencing dividend payments could be a company's policy to pay constant dividends to attract and retain equity holders by constant returns.

8.5.2. What is the implied acquisition premium associated with the three offers made by Broadcom to the shareholders of Qualcomm? Analyze the different offers and discuss their components.

To analyze the offers, the different components as well as the offered amount must be examined. It is important to analyze the potential benefit and shortcomings from the perspective of both the acquirer and the target (Appendix 19). To evaluate the offers from the target's perspective, the view of shareholders has been taken since it is their decision to accept or reject the offer. All three offers were publicly announced, made to all shareholders, and consisted of a cash and a stock component, therefore representing a mixed offering. Generally speaking, the main distinction between the two forms of compensation is the exposure to risk. In a cash transaction, the entire risk of the synergy premium being achieved after the merger is borne by the acquiring company and its shareholders, while in a stock transaction this risk is being shared with the selling shareholders. The amount of risk that each group is exposed to in the latter form is determined by the proportion of ownership in the combined entity (Rappaport and Sirower 1999).

Payment in cash

Cash payment is the most common and simplest form of payment and provides the target's shareholders with immediate liquidity. Upon completion of the acquisition and the final closing the shareholder of the target company receives the predefined amount of cash in return for the

shares held. If the cash payment is higher than the current actual trading price selling shareholders immediately receive a premium over the market price and are not reliant on stock appreciation. They are therefore less prone to market fluctuations and receive immediate compensation in exchange for their share of equity. Furthermore, the simplicity in assessing the value offered exceeds the one of alternative compensation while also offering a lower-risk asset than the before-held equity. From the acquirer's perspective the advantages differ slightly. Besides the simple nature and the concomitant faster closing it is the unaltered ownership structure and corporate identity that present an edge over other forms of payment (Wansley, Lane, & Yang 1983).

Nevertheless, a payment in cash also imposes some disadvantages. Shareholders accepting the cash payment lose out on the upside potential. Compared to a payment in equity in the acquiring company, the seller will not receive additional value from a positive stock performance of the acquirer. This is especially relevant when the post-acquisition entity will be able to leverage their newly gained market position and power. The origins of those can arise from decreased cost of capital, improved bargaining power, economies of scale or higher revenue potential owed to up or cross selling, amongst others. Other disadvantages are the reduced diversification and the immediate payment of taxes on financial gains. From the acquirer's perspective potential constraints associated with a cash payment might be seen as a drawback while this, certainly, mainly applies to acquisitions where the funds originate from external sources (Sankar 2018). Additionally, taking on additional debt to finance the takeover might cause direct as well as indirect costs in the form of interest payments and opportunity cost, respectively.

Stock component

When offering a payment in stock there are two main exchange alternatives, exchanging a fixed number of shares or compensating sellers with a fixed value. The former one guarantees the

seller a predefined number of shares meaning that the corresponding value may fluctuate depending on the underlying share price of the acquirer. Under this deal type, the ownership structure remains the same, independent of the share price at closing date and both the acquiring and the selling shareholders are affected by changes in stock prices. The opposite is a fixed-value offer, wherein the number of shares that the seller receives depends on the share price at closing. In this case the acquirer bears all the risk of changes in stock price between the announcement and the final closing (Rappaport and Sirower 1999).

The biggest advantage of a payment in stock is the potential to benefit from the acquirer's future growth and value creation and the subsequent stock appreciation. The profit therefore is not solely dependent on the underlying transaction but also influenced by the performance of the acquiring company. Potential upside can be derived either from firm-specific events, or an overall market trend or both. Moreover, the newly acquired ownership can also be seen as an opportunity to diversify the shareholder's investment portfolio by gaining exposure to a different company's stock.

When looking at shareholders employed by the target company, especially in management positions, an ownership share in the combined entity ensures an alignment of interest similar to an earnout, as part of the compensation is based on the performance of the acquirer. Another advantage is the deferral of taxes on the payment in stock. When being paid in stocks the recipient is not taxed when shares are received but at the event of liquidation. The event of taxation is therefore pushed to a later date. Since the implications on the overall tax burden are contingent on the shareholder's individual tax rate, it might not always be beneficial to postpone the event of taxation. By financing an acquisition with equity, the acquirer can exploit market inefficiencies stemming from information asymmetry. More precisely, a company will only issue new shares if it believes that the market value exceeds the true value (e.g., Myers and Majluf 1984). This presents an opportunity for the buyer to take advantage of overvaluation.

Nevertheless, there are also some caveats associated with the payment being made in stocks. The most apparent one is the exposure to market volatility and fluctuations in share price, potentially resulting in a loss of value. Share price declines might stem from firm-specific underperformance, general industry or macroeconomic trends, or a failed materialization of anticipated synergies, both in terms of cost and revenue synergies. Further, the exchange of shares does not provide the seller with immediate liquidity, which can even be extended by additional clauses agreed upon during the acquisition. The majority shareholders in the acquiring company might also oppose a payment in stock when the issuance of new equity leads to dilution and a loss of majority ownership and, correspondingly, control (Feito-Ruiz 2013).

As the offers made by Broadcom represent a mixed offering of cash and stock the risk of synergies materializing is partly shared between the acquirer and the seller, although the risk of changes in share price is borne by Broadcom due to the fixed value of equity. The sellers are offered a fixed compensation for their share but are also able to benefit from the upside potential by owning shares in the acquiring company. In all offers, the cash component constitutes at least 72% of the value of the compensation. As part of the first offer, selling shareholders are offered $60 in cash (85% of the overall value) and $10 in stock (14%). While the share of cash is the largest in the first offer the equity stake offered in the combined company is the smallest. Qualcomm shareholders' overall compensation is therefore not as exposed to Broadcom's stock performance after the closing as in the other offers. The second and third bit are very similar to each other with the stock component being $22 and only the cash component dropping from $60 to $57 owing to the increased offer that Qualcomm made to NXP. In these two offers the ratio of the stock component is about 27% and 28%, respectively. Accordingly, they offer a bigger opportunity to profit from future stock performance. From a pure component perspective, all offers ensure a high fixed compensation and immediate liquidity in the form of cash while also allowing participation in the value creation in the merged entity. The exposure

to market fluctuation can be neglected bearing in mind that shareholders are in fact reducing their capital invested in stock and therefore their investment being prone to changes in market value. The argument for additional diversification is only slightly valid since shareholders will receive equity in a very similar company. The amount of ownership that Qualcomm shareholders would have in the company depends on the stock price at closing but will most likely not change the ownership structure significantly and since the payment is mainly in cash it is unlikely that Broadcom is taking advantage of a perceived overvaluation. With part of the payment being offered in stock selling shareholders also bear part of the materialization risk of synergies and the ascribed value to Qualcomm.

Acquisition premium

As mentioned above, all offers made by Broadcom consisted of a payment in cash, ranging from $57 to $60, plus a fixed value of equity in the acquiring company, ranging from $10 to $22. The amount of compensation, therefore, does not change between announcement, signing and closing. To evaluate the implied acquisition premium, the offers need to be compared to the market value, to the closing price of the last unaffected trading day, November 2nd, 2017, as well as to the 1-month volume-weighted average price. The former price was $54.84, while the latter one amounts to $53.02. The implied premiums can be seen in Appendix 20. The offered bids all represent a strong premium over both prices calculated. The first offer represents a premium of ~28% over the former and of ~32% over the latter. The second bid offers an almost 50% premium over the last unaffected closing price and almost ~55% over the 1-month volume weighted average closing price. The last offer constituted a premium of 44% and 49% respectively. The offers are therefore all include an acquisition premium over the market value.

Further it is important to compare the offers to the valuations and correspondent share prices calculated in the prior question. The first offer includes a premium over the trading prices but

is below all share prices calculated, meaning a premium over the market value but undervaluing the company significantly with the lowest computed share price obtained by the DDM model being $5.43 higher than the first offer ($70 vs. $75.43). The second offer of $82, poses a slight premium over the values obtained through DCF and comparable valuation ($81.07 and $81.01). Assuming the DCF does not incorporate potential synergies, sellers participate in additional value creation only by receiving a share in Broadcom's equity. The third offer came as a reaction to the increased bid made by Qualcomm for NXP. Since a more profound analysis of the difference between the second and the third offer would require an analysis of the NXP offer, a profound discussion of the last offer would impose an excessive effort. Looking at the share prices calculated, the final offer presents a premium over the trading prices and DDM but undervalues the company compared to the DCF and the comparable valuation.

8.5.3. Why might the DCF model not result in a perfect estimate for the value Broadcom assigned to Qualcomm? Re-calculate Qualcomm's value using Broadcom's R&D spending.

When valuing a company with a DCF model the major assumption is that the business is going to continue operating the way it has been doing in the past. It therefore does not incorporate any inorganic growth, strategic readjustment, or changes in the cost structure. As mentioned earlier, Broadcom is known for cutting down costs to maximize short-term returns to shareholders, partly driven by the majority shareholder Silver Lake. This is especially important for the R&D expenses as Qualcomm's portion of the very is significantly higher than the one from Broadcom in relation to revenue. It is reasonable to assume that, once the acquisition is successful and the target has been fully integrated, research expenditures are going to be cut dramatically (McGregor 2017). Under this assumption the calculation of future FCF changes significantly ultimately leading to a higher valuation. Looking at Broadcom's expenditures in the last 5 years they spent on average ~17.3% of revenue on research and development. Applying this number

to the forecast of value drivers and FCF, the enterprise value of Qualcomm increases from ~$109 billion to ~$121 billion with a corresponding equity value of ~$132 billion and a share price of $89.42. This represents an increase of ~11% in enterprise value and a share price increase of ~10%. The result can be interpreted as the maximum value of Qualcomm if no other cost or revenue synergies are to be realized.

Comparing the resulting share price to the three offers it becomes evident that Qualcomm shareholders are compensated with a premium over the current trading price but might not be offered a fair compensation based on the value that Broadcom might be able to generate by the acquisition. Participation in possible additional value creation is ensured by receiving equity in the acquirer.

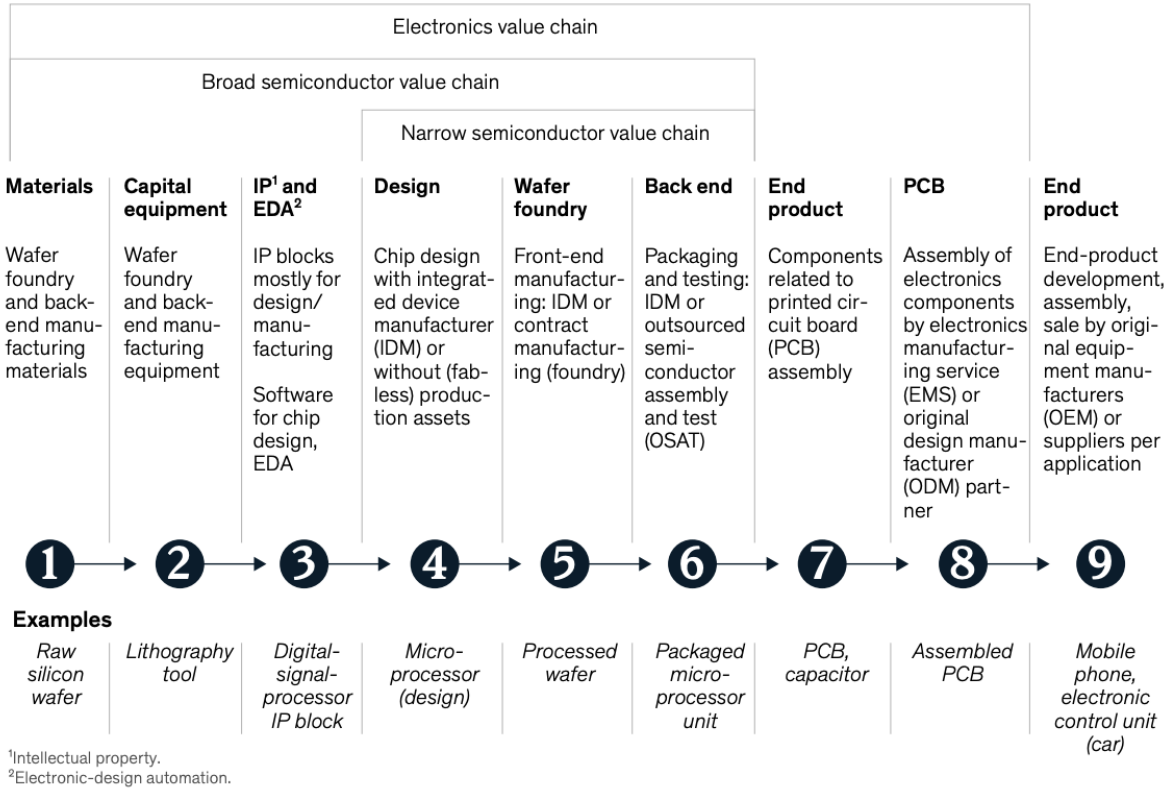
Furthermore, there are other factors influencing the value of a deal and the transaction itself, such as competition and overall industry trends. Due to several reasons, there has been high M&A activity in the industry and with the role of regulators, especially in this deal, the deal approval might be tied to further concessions and conditions which might come with additional costs. Due to the importance of semiconductors and chips for the overall economy and certain areas such as the 5G network the deal might not only be dependent on the financial viability but also to more macroeconomic and strategic factors, such as the possibility of American companies falling behind in the development of new technology as a result of the deal. Dominance of Chinese players, already strong in the supply of 5G infrastructure could become unavoidable, possibly leading to the American 5G industry falling behind and being dependent on Chinese products to establish a reliable 5G network (McGregor 2017).

9. Appendix

Appendix 1: Donald Trump and Hock Tan in the White House.

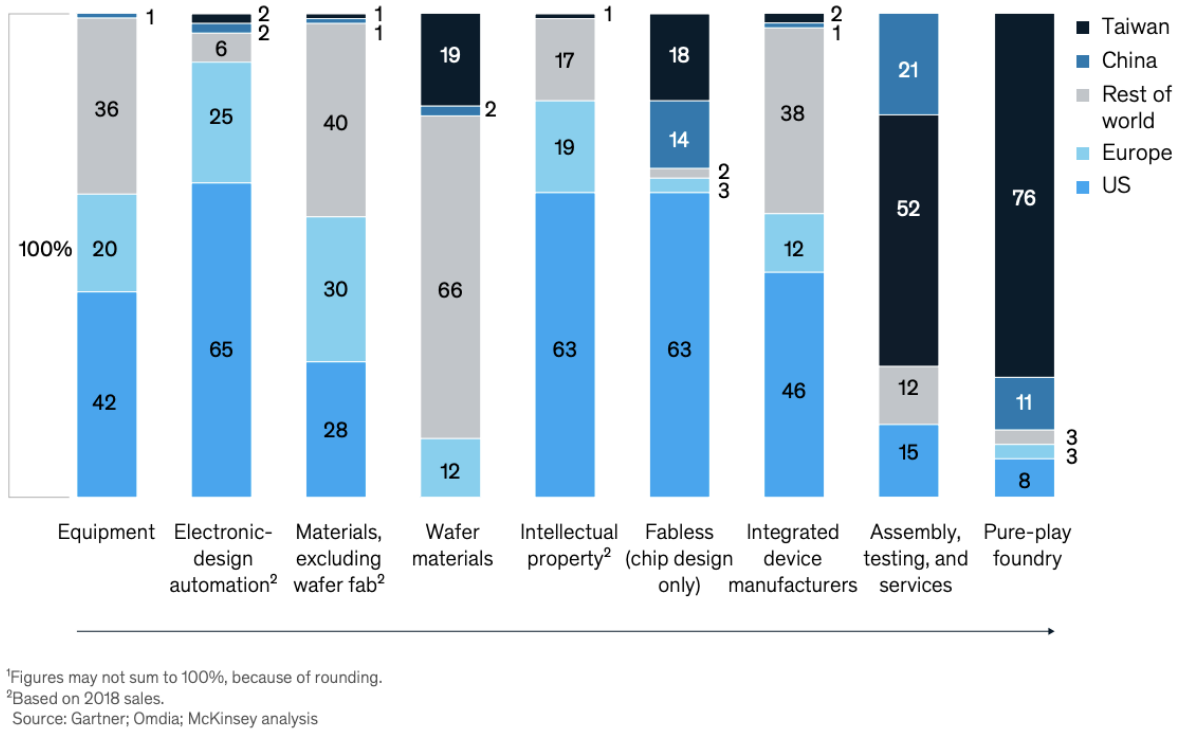
Source: Bloomberg Television on Youtube, 2017.

Appendix 2: Value Chain Areas.



Source: McKinsey & Company

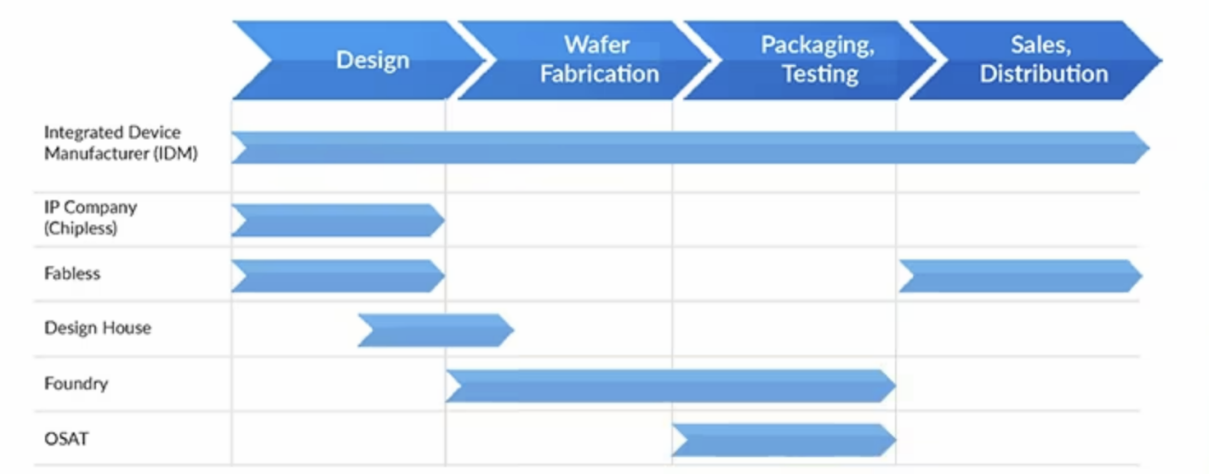
Appendix 3: 2018 semiconductor sales along the value chain.



[1]Figures may not sum to 100%, because of rounding.
[2]Based on 2018 sales.
Source: Gartner; Omdia; McKinsey analysis

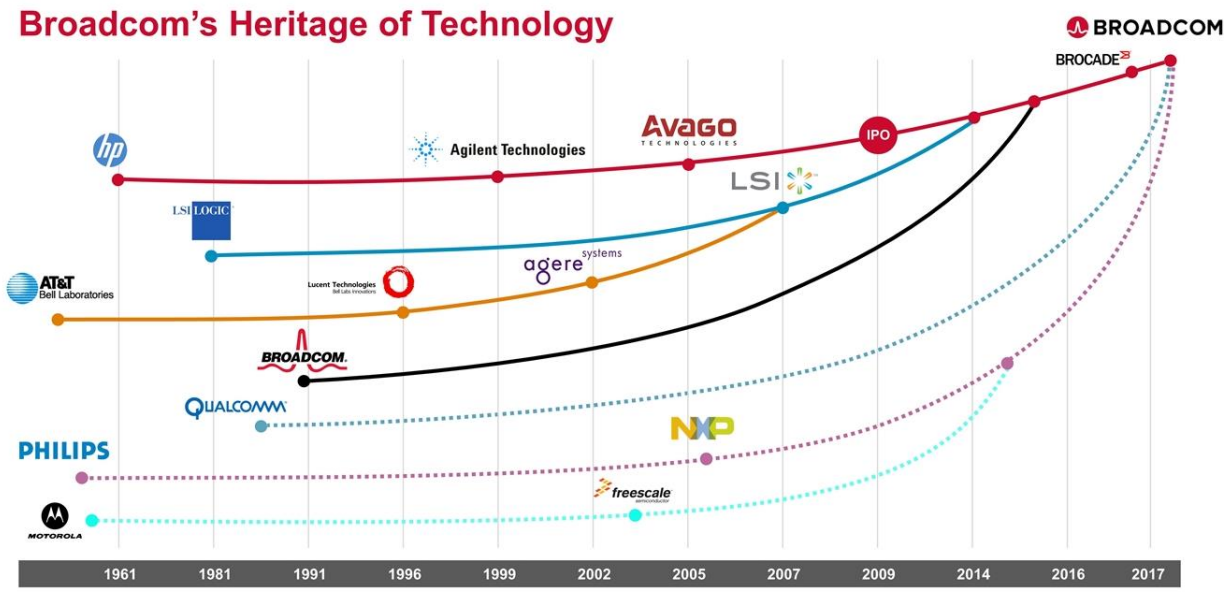
Source: McKinsey & Company

Appendix 4: The Semiconductor Ecosystem.



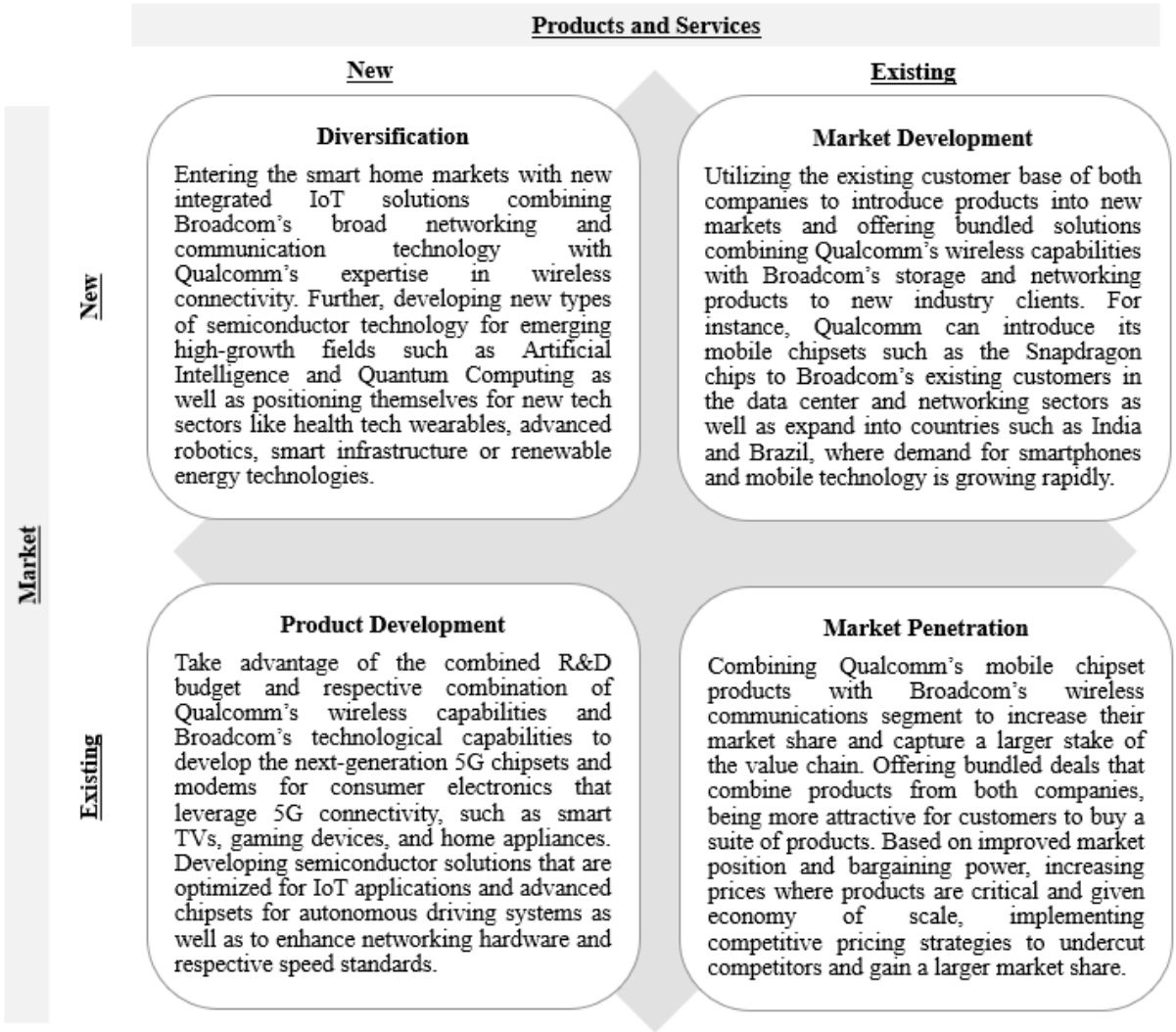
Source: Samsung Semiconductor

Appendix 5: Broadcom's Heritage of Technology.



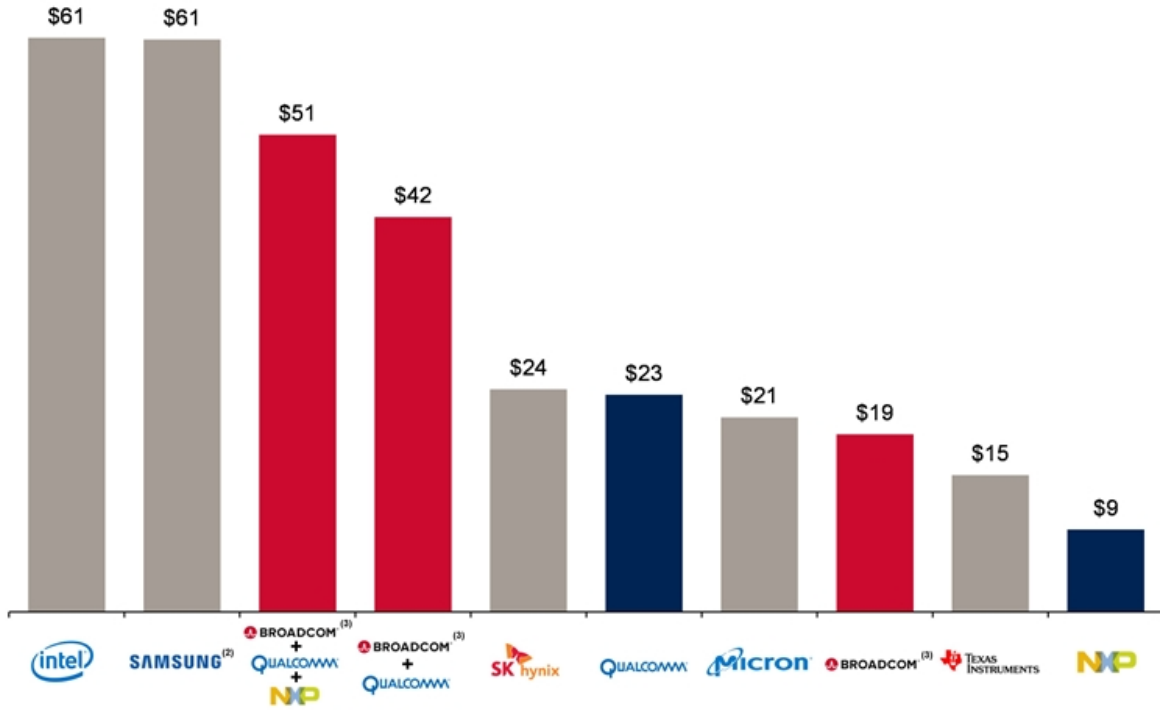
Source: Broadcom, 2018.

Appendix 6: Ansoff matrix.



Source: Own illustration

Appendix 7: Global Semiconductor Industry Leadership by 2017 LTM revenue (in $B).



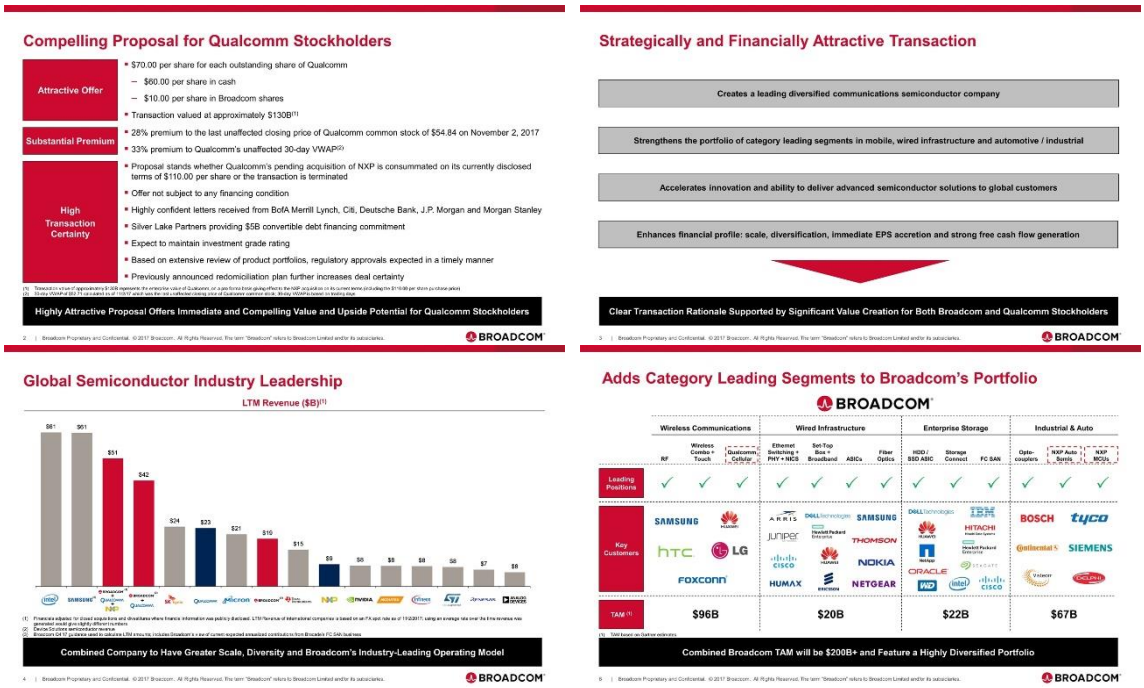
Source: Broadcom, 2018.

Appendix 8: Market coverage of combined entity by market segment.

Wireless Communications			Wired Infrastructure				Enterprise Storage			Industrial & Auto		
RF	Wireless Combo + Touch	Qualcomm Cellular	Ethernet Switching + PHY + NICS	Set-Top Box + Broadband	ASICs	Fiber Optics	HDD / SSD ASIC	Storage Connect	FC SAN	Opto-couplers	NXP Auto Semis	NXP MCUs
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

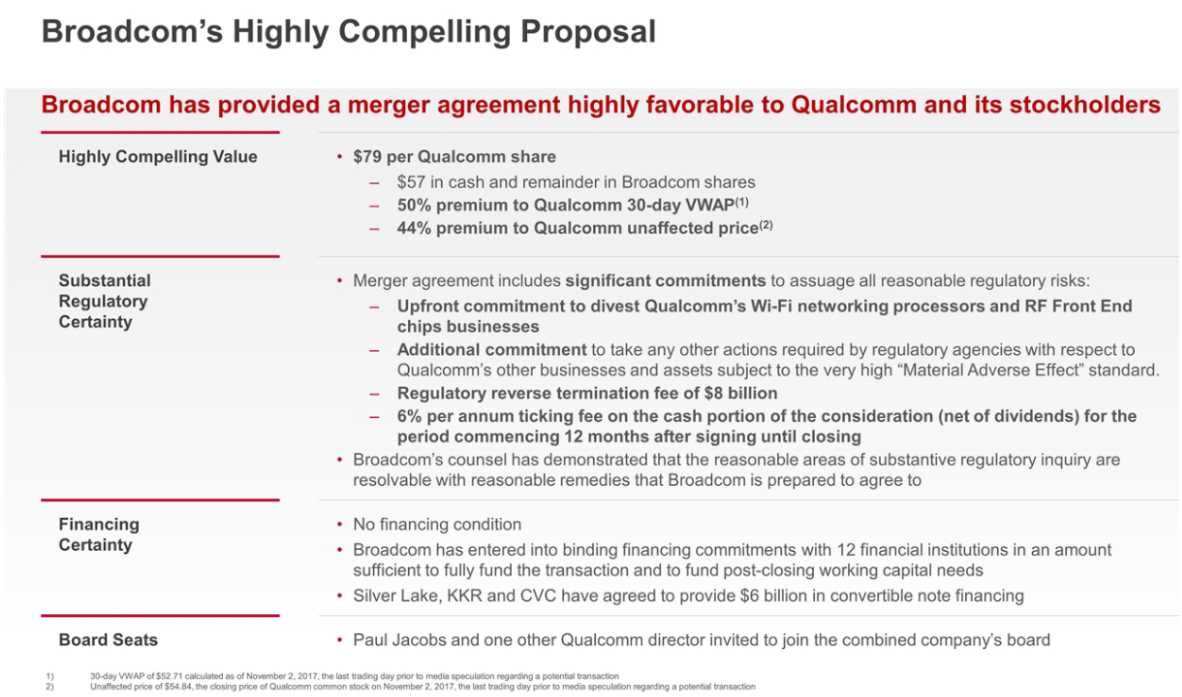
Source: Broadcom, 2018.

Appendix 9: Broadcom's first proposal to acquire Qualcomm.



Source: Broadcom, 2017.

Appendix 10: Broadcom's third offer.



Source: Broadcom, 2018b.

Appendix 11: Overview of valuation methodologies.

Scope of valuation	Method	Description
Intrinsic	DCF	PV of future FCF Discount factor: WACC
	DDM	PV of future dividend payments Discount factor: cost of equity
Extrinsic	CTA	Multiple valuation (revenue or profitability measures) from comparable precedent transactions
	CCA	Multiple valuation (revenue or profitability measures) from publicly listed comparable companies

Source: Own illustration

Appendix 12: WACC calculation.

WACC	
Debt	21,951.0
Equity	30,746.0
Enterprise Value	52,697.0
D/E	71.4%
D/V	41.7%
E/V	58.3%
Tax rate	17.0%
rf	2.25%
rD	2.11%
Beta	1.42
MRP	5.70%
rE	10.37%
WACC	**6.78%**

Source: Own illustration

Appendix 13: Forecast of revenue and other line items.

Qualcomm Inc - Forecast	Historical					Forecast				
USD million	2013A	2014A	2015A	2016A	2017A	2018E	2019E	2020E	2021E	2022E
Date	29.09.2013	28.09.2014	27.09.2015	25.09.2016	24.09.2017	30.09.2018	29.09.2019	27.09.2020	26.09.2021	25.09.2022
Time period						0.92	1.93	2.94	3.96	4.97
Income Statement Items										
Total Revenue	**24,866.0**	**26,487.0**	**25,281.0**	**23,554.0**	**22,258.0**	**23,028.7**	**22,578.1**	**23,078.4**	**23,536.9**	**24,004.6**
Growth	*n/a*	*6.5%*	*-4.6%*	*-6.8%*	*-5.5%*	*3.5%*	*-2.0%*	*2.2%*	*2.0%*	*2.0%*
Revenue Split										
Operating Expenses	**17,305.0**	**18,147.0**	**17,854.0**	**16,669.0**	**17,935.0**	**17,305.0**	**16,966.4**	**16,188.5**	**16,510.1**	**16,838.2**
Non-operating items	**1,037.0**	**1,397.0**	**891.0**	**518.0**	**551.0**	**639.6**	**589.6**	**572.2**	**620.9**	**632.9**
Non-recurring items	**(404.0)**	**(959.0)**	**(1,831.0)**	**(498.0)**	**(1,887.0)**	**(1,600.5)**	**(1,569.0)**	**(1,604.0)**	**(1,636.1)**	**(1,668.8)**
Gross Profit	**15,046.0**	**16,052.0**	**15,175.0**	**14,239.0**	**12,466.0**	**13,706.5**	**13,438.3**	**13,736.1**	**14,009.0**	**14,287.4**
Operating Profit	**7,561.0**	**8,340.0**	**7,427.0**	**6,885.0**	**4,323.0**	**5,723.7**	**5,611.7**	**6,890.0**	**7,026.8**	**7,166.5**
D&A	**1,017.0**	**1,152.0**	**1,216.0**	**1,428.0**	**1,461.0**	**1,195.5**	**1,172.1**	**1,198.1**	**1,221.9**	**1,246.2**
EBITDA	**8,578.0**	**9,492.0**	**8,643.0**	**8,313.0**	**5,784.0**	**6,919.2**	**6,783.8**	**8,088.0**	**8,248.7**	**8,412.6**
Income before taxes	**8,194.0**	**8,778.0**	**6,487.0**	**6,905.0**	**2,987.0**	**4,762.8**	**4,632.3**	**5,858.2**	**6,011.7**	**6,130.6**
Taxes	**1,349.0**	**1,244.0**	**1,219.0**	**1,131.0**	**543.0**	**809.7**	**787.5**	**995.9**	**1,022.0**	**1,042.2**
Effective tax rate	*16.5%*	*14.2%*	*18.8%*	*16.4%*	*18.2%*	*17.0%*	*17.0%*	*17.0%*	*17.0%*	*17.0%*
Discontinued operations	-	430.0	-	-	-	-	-	-	-	-
Net income	**6,845.0**	**7,964.0**	**5,268.0**	**5,774.0**	**2,444.0**	**3,953.1**	**3,844.8**	**4,862.3**	**4,989.7**	**5,088.4**

Appendix 14: Forecast and PV of FCF.

Qualcomm Inc - DCF	Historical					Forecast				
USD million	2013A	2014A	2015A	2016A	2017A	2018E	2019E	2020E	2021E	2022E
Date	29.09.2013	28.09.2014	27.09.2015	25.09.2016	24.09.2017	30.09.2018	29.09.2019	27.09.2020	26.09.2021	25.09.2022
Time period						0.92	1.93	2.94	3.96	4.97
Revenue	**24,866.0**	**26,487.0**	**25,281.0**	**23,554.0**	**22,258.0**	**23,028.7**	**22,578.1**	**23,078.4**	**23,536.9**	**24,004.6**
Growth	*n/a*	*6.5%*	*-4.6%*	*-6.8%*	*-5.5%*	*3.5%*	*-2.0%*	*2.2%*	*2.0%*	*2.0%*
EBIT	**7,561.0**	**8,340.0**	**7,427.0**	**6,885.0**	**4,323.0**	**5,723.7**	**5,611.7**	**6,890.0**	**7,026.8**	**7,166.5**
D&A	1,017.0	1,152.0	1,216.0	1,428.0	1,461.0	1,195.5	1,172.1	1,198.1	1,221.9	1,246.2
EBITDA	**8,578.0**	**9,492.0**	**8,643.0**	**8,313.0**	**5,784.0**	**6,919.2**	**6,783.8**	**8,088.0**	**8,248.7**	**8,412.6**
EBITDA Margin	*34.5%*	*35.8%*	*34.2%*	*35.3%*	*26.0%*	*30.0%*	*30.0%*	*35.0%*	*35.0%*	*35.0%*
Tax rate	*16.5%*	*14.2%*	*18.8%*	*16.4%*	*18.2%*	*17.0%*	*17.0%*	*17.0%*	*17.0%*	*17.0%*
Tax expense	1,244.8	1,181.9	1,395.6	1,127.7	785.9	973.0	954.0	1,171.3	1,194.6	1,218.3
NOPAT	**6,316.2**	**7,158.1**	**6,031.4**	**5,757.3**	**3,537.1**	**4,750.6**	**4,657.7**	**5,718.7**	**5,832.3**	**5,948.2**
CAPEX	**1,240.0**	**2,031.0**	**3,725.0**	**1,351.0**	**2,234.0**	**1,525.1**	**1,495.2**	**1,528.4**	**1,558.7**	**1,589.7**
% of revenues	5.0%	7.7%	14.7%	5.7%	10.0%	6.6%	6.6%	6.6%	6.6%	6.6%
NWC	**10,729.6**	**11,141.7**	**10,967.1**	**12,079.4**	**12,000.6**	**9,558.5**	**9,142.2**	**9,158.6**	**9,257.9**	**9,320.5**
% of revenues	43.1%	42.1%	43.4%	51.3%	53.9%	41.5%	40.5%	39.7%	39.3%	38.8%
Change in NWC		412.1	(174.6)	1,112.3	(78.8)	(2,442.1)	(416.3)	16.4	99.3	62.6
FCF	**6,093.2**	**5,867.0**	**3,697.0**	**4,722.0**	**2,842.9**	**6,863.1**	**4,750.9**	**5,372.0**	**5,396.1**	**5,542.1**
PV of FCF						**6,460.3**	**4,185.1**	**4,428.6**	**4,163.1**	**4,001.4**

Appendix 15: Sensitivity analysis of Qualcomm's enterprise value.

Terminal growth rate	Cost of Capital				
	5.78%	6.28%	6.78%	7.28%	7.78%
1.0%	111,866.2	101,613.1	93,181.5	86,134.7	80,165.1
1.5%	122,714.4	110,243.1	100,186.3	91,915.6	85,003.1
2.0%	136,434.0	120,890.3	108,657.1	98,791.8	90,678.3
2.5%	154,338.7	134,355.6	119,107.9	107,107.1	97,428.8
3.0%	178,688.4	151,928.6	132,324.8	117,366.0	105,592.1

Source: Own illustration.

Appendix 16: Past transactions in the semiconductor industry (non-exhaustive).

Comparable Transactions				Multiples			
Date	Target	Buyer	Deal Value	EV/Revenue	EV/EBITDA	EV/EBIT	Earnings
Sep 17	Imagination Technologies Group Limited	Canyon Bridge Capital Partners	786.7	4.00x	24.60x	74.20x	n/a
Sep 17	IR Newport Limited	Neptune &	18.0	0.10x	0.60x	1.90x	n/a
Apr 17	Compound Semiconductor Technologies Global	Sivers Semiconductors	26.9	5.30x	n/a	n/a	n/a
Jan 17	Norstel AB	An Xin Capital	24.8	11.80x	n/a	n/a	n/a
Dez 16	e2v technologies	Teledyne Technologies	909.6	2.70x	12.10x	16.30x	20.40x
Okt 16	Atotech B.V.	Carlyle Group Inc	3,424.6	2.90x	11.80x	n/a	n/a
Jul 16	ARM (SVF Holdco)	Softbank Group	32,649.4	23.90x	51.60x	56.90x	71.10x
Jun 16	Cemat A/S	National Silicon Industry Group Co Ltd	59.1	1.30x	20.90x	n/a	n/a
Jun 16	Hermes Microvision Inc	ASML Holding NV	2,950.9	13.80x	35.70x	37.00x	44.00x
Apr 16	Greenpeak Technologies	Qorvo Inc.	135.3	3.50x	53.00x	68.10x	50.40x
Apr 16	Okmetic Oy	National Silicon Industry Group Co Ltd	187.0	1.90x	10.70x	20.90x	32.90x
Dez 15	Micronas Semiconductor Holding	TDK Corporation	276.9	1.60x	13.90x	39.10x	62.50x

* numbers in million USD except multiples

Source: Mergermarket.

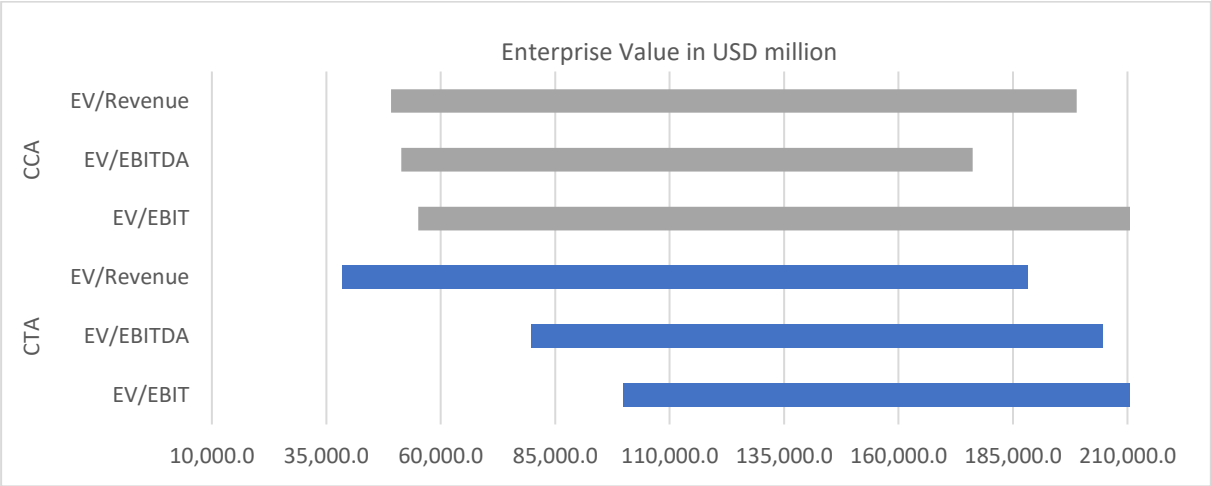
Appendix 17: Overview of multiples from CTA and CCA.

CTA - Multiple Valuation	25th percentile		Median		75th percentile	
	Multiple	Implied EV	Multiple	Implied EV	Multiple	Implied EV
EV/Revenue	1.7x	38,573.0	3.2x	73,691.8	10.2x	234,316.9
EV/EBITDA	11.5x	79,743.5	17.4x	120,393.7	39.7x	274,518.4
EV/EBIT	17.5x	99,878.1	38.1x	217,785.8	65.3x	373,755.8

CCA - Multiple Valuation	25th percentile		Median		75th percentile	
	Multiple	Implied EV	Multiple	Implied EV	Multiple	Implied EV
EV/Revenue	2.1x	49,166.2	3.4x	78,643.0	6.5x	149,744.0
EV/EBITDA	7.4x	51,409.5	10.3x	71,232.9	18.0x	124,804.7
EV/EBIT	9.6x	55,061.7	15.7x	89,661.3	33.4x	191,113.4

Source: Own illustration

Appendix 18: Overview of Qualcomm's Enterprise Value based on multiples.



Source: Own illustration.

Appendix 19: Advantages and disadvantages of payment component for each party with "T" being the target and "A" the acquirer.

Form of Payment	Advantages	Disadvantages
Cash	• Immediate Liquidity • Reduced risk • Simplicity • Unaltered ownership structure	• Loss of upside potential • Limited diversification • Tax payment • Financial constraints and costs
Stock	• Participation in future growth • Diversification opportunity • Alignment of interests • Tax deferral • Capitalize on overvaluation	• Exposure to market fluctuation • Lack of immediate liquidity • Regulatory and compliance issues • Potential loss of control

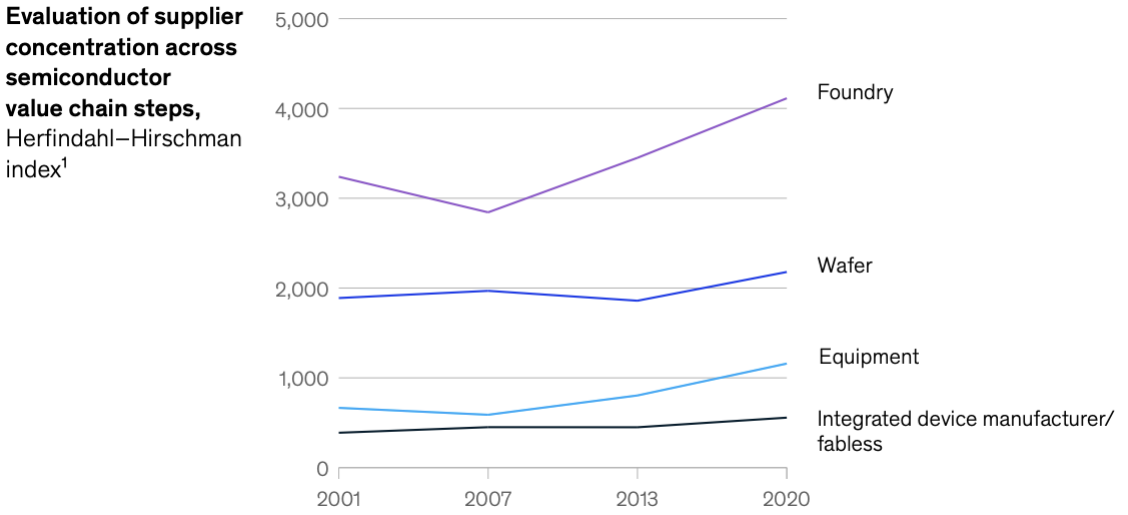
Source: Own illustration.

Appendix 20: Offer premiums over share price.

Premium	1st offer	2nd offer	3rd offer
Last unaffected trading day	27.64%	49.53%	44.06%
1-month volume weighted average	32.03%	54.66%	49.00%

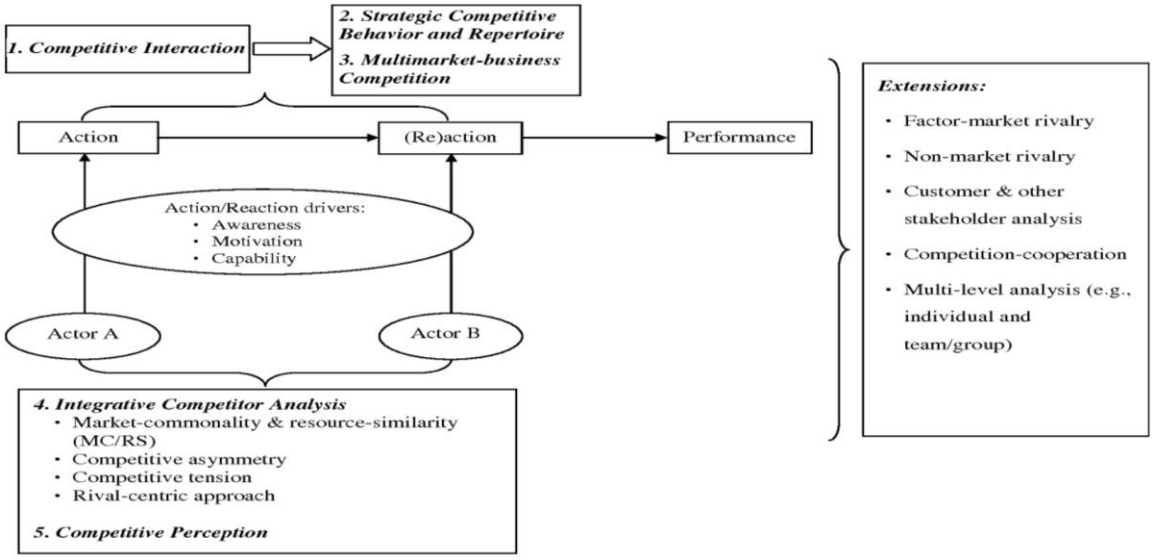
Source: Own illustration.

Appendix 21: Increasing consolidation in the semiconductor industry.



Source: McKinsey 2021.

Appendix 22: AMC Framework.



Source: Chen & Miller 2012.

Appendix 23: AMC Framework explained.

AMC Framework	
Three implicit drivers that influence assertive competitive behavior are identified by the theoretical framework within competitive dynamics. When combined, the components of the AMC framework represent competitors' competitive tension, or as Chen et al. (2007) put it, "the strain between a focal firm and a given rival that is likely to result in the firm taking action against the rival.	
Driver 1: The awareness of rivals	The awareness of a competitor's dependency on other businesses depends on how reliant the competitor is on shared markets and how similar its resources are to those of its rivals (Chen, 1996). Market dependency is the proportion of sales or earnings that a business gets from a certain product market; the larger the percentage, the more reliant the business is on that market.
Driver 2: The motivation to engage in competitive behavior with one another	Companies that depend on similar markets as merging firms feel pressured to defend their standing in the event that competitors act in a way that puts them in danger. Comparable resource companies are likely to think they can compete on an equal footing, follow comparable strategies, and have comparable capabilities and limits.
Driver 3: The capability to perform such actions	A company's capacity to respond to the actions of its rivals is determined by its resources, which include its human and financial capital (Chen, 1996) and its organizational slack. Compeitors with high degree of slack are better able to respond quickly and effectively to changes in the external environment and adjust their strategy than enterprises with limited resources

Source: Own illustration

Appendix 24: Market reliance and resource similarity.

Source: Own illustration

Appendix 25: Horizontal Merger Guidelines.

1. Market Definition, Measurement, and Concentration:

In the first step the scope of products or services as well as the geographical area affected by a merger are determined. This is important to understand the competitive landscape and give the analysis guardrails, as a good understanding of the market on hand including geographies, relevant players and trends helps in all subsequent steps of the analysis.

2. The Potential Adverse Competitive Effects of Mergers:

The second step involves analyzing if and how the merger could diminish competition in a market. Antitrust regulation aims at preventing merged companies from gaining or exercising to much market power, because this may lead to a reduction in rivalries, possible collusion of big players in an oligopoly or the creation of a monopoly in the market.

3. Entry Analysis:

For the third step post-merger changes to any entry barriers are evaluated, that could potentially offset negative effects of the deal. To counteract adverse impacts of the deal on hand, entries must be timely, likely, and sufficient.

4. Efficiencies (Revised: April 8, 1997):

The fourth step analysis focuses on whether the merger would result in efficiency gains that could not be achieved by the firms separately. These again must be substantial and could not reasonably be achievable through other means.

5. Failure and Exiting Assets:

In the fifth and final step, the likelihood of one of the involved companies failing if the deal does not occur, leading to company assets to exit the market. This is also known as the "failing firm defense".

Source: Own illustration, based on FTC and DOJ 1992

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