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Measuring Smartphone Competitiveness: The Case of Huawei Mate 40 and Apple iPhone 12

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Abstract: *This paper examines the impact of the Sino-US trade war on Smartphone Competitiveness and proposes a comprehensive Smartphone Competitiveness Assessment Model to evaluate product competitiveness which integrates supply chain competitiveness, market competitiveness and ecological competitiveness. 33 indicators were conducted in empirical analysis to compare Mate 40 and iPhone 12 under different trade scenarios.*

Keywords: *smartphone; competitiveness; decoupling*

1. Introduction

China's smartphone manufacturing has a globalized characteristic. For a long time, China imports various precision components from the western countries, participates in international market through domestic processing, assembly and exports the whole machine to the countries all over the world. This assembly-type model is the basis for the international industrial competitiveness of China's smartphone industry. Since the Sino-US trade war, China's telecommunication companies represented by Huawei have been hit hard. In 2022 China's smartphone shipments were 264 million, declined by 23.1% y-o-y. China's 5G mobile phone shipments were 214 million units, declined by 19.6% y-o-y[1-2]. Both the academia and the policy realm have argued that the issue of smartphone must be assessed in the broader geopolitical context [3]. Trade friction between China and the U.S. intensifies and U.S. companies marginalize China in the global division of labor, the competitiveness of China's smartphone will be under serious challenges [4]. This paper examines the smartphone competitiveness with the case of Mate 40 from Huawei and iPhone 12 from Apple and try to draw some conclusions.

2. Literature review

2.1 Measuring product competitiveness

Product competitiveness is an important concept in the field of marketing and is often used to assess the success of a product. Product competitiveness refers to the ability of a product to meet the needs of customers in a given market while competing with other products on differentiation, price, quality, brand reputation and marketing efforts. Product differentiation contributes to competitiveness, which refers to the unique features and attributes of a product that distinguish it from other products in the market [5]. According to Porter's Five Forces Model, product differentiation is one of the key ways in which firms can gain a competitive advantage in the marketplace [6]. A product that is highly differentiated is more likely to be successful in the market. Price is another key factor in the purchasing decision of customers [7]. However, it is important to note that price alone is not enough to ensure product competitiveness, as customers also consider quality and brand reputation. Quality can be assessed in terms of durability, reliability, and performance, among other factors [8]. Brand reputation and marketing efforts can also contribute to product competitiveness. A strong brand reputation can increase the perceived value of a product and make it more competitive [9].

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2.2 Factors of smartphone competitiveness

The increasing prominence of smartphones in today's society has fueled intense competition among manufacturers striving to gain a competitive edge. As a result, numerous studies have focused on developing methodologies to measure smartphone competitiveness. This literature review aims to explore various approaches and frameworks used in the field of smartphone competitiveness measurement.

Firstly, smartphone competitiveness can be assessed by technological features through which testers evaluate smartphone with processor speed, camera quality, screen resolution, battery life, and software capabilities [10-11]. The presence of cutting-edge features and continuous technological advancements such as 5G signifies obvious competitive advantage for a smartphone brand. Therefore, the network infrastructure and connectivity options offered by a brand which connect with network coverage, download and upload speeds, availability of 4G/5G connectivity, and compatibility with different network technologies provide a smartphone brand with a reliable and extensive network infrastructure competitive advantage [12]. Price and affordability play a crucial role in assessing smartphone competitiveness, pricing strategies of different smartphone brands with similar features reflect the supply chain competitiveness [13-14].

Secondly, researchers examine the market share of different smartphone brands and their corresponding sale performance [15]. Higher market share and shipment volume are considered indicators of greater competitiveness.

Thirdly, surveys, interviews, and online reviews are employed to gauge smartphone user satisfaction levels, loyalty, and service experience with a particular smartphone. Higher customer satisfaction and positive software experiences are indicative of a more competitive product [16-17]. The reputation and marketing efforts of a smartphone brand contribute significantly to its competitiveness. Brand perception, recognition, and loyalty play key roles for smartphone [18-19]. A strong brand reputation coupled with effective marketing campaigns enhances a smartphone competitiveness in the new market.

2.3 Competitiveness of Huawei and Apple smartphones

Apple and Huawei are two prominent players in the global smartphone market, known for their innovative products and competitive strategies. Numerous studies have highlighted Apple's product competitiveness in terms of design and user experience. Apple's iPhones are renowned for their sleek aesthetics, user-friendly interfaces, and seamless integration with the iOS ecosystem. The company's attention to detail and commitment to providing a premium user experience as key drivers of Apple's competitive advantage [20-21].

Both Apple and Huawei have been at the forefront of technological innovation in the smartphone industry. Studies discuss Apple's consistent focus on introducing cutting-edge features and functionalities, such as facial recognition technology (Face ID), advanced camera systems, and augmented reality capabilities [22]. Huawei's products, particularly its flagship smartphones, have gained recognition for powerful processors, high-resolution cameras, and advancements in 5G technology. Studies also examine Apple ability to maintain profitability while charging a premium price as a testament for perceived product value [23] while Huawei has positioned as a more affordable alternative in certain markets, offering competitive pricing while delivering advanced features.

Market share analysis provides insights into the competitiveness of Apple and Huawei. Studies discuss Apple's significant presence in developed markets, where it has consistently maintained a sizable market share [24]. Huawei, primarily known for its success in the Chinese market, has witnessed substantial growth in global market share, particularly in emerging markets, driven by its mid-range and budget-friendly smartphone shipment.

The software ecosystem and app store play a crucial role in the competitiveness of Apple and Huawei. Researchers emphasize the advantages of Apple's tightly integrated ecosystem, which includes a robust app store and seamless synchronization across multiple devices [25]. Huawei's ecosystem, while developing, has seen progress with the Huawei App Gallery and efforts to enhance app compatibility. Brand perception and customer loyalty significantly contribute to the product competitiveness of Apple and Huawei. Research suggests that Apple enjoys a strong brand reputation and loyal customer base, with its products often associated with quality and innovation [26]. Huawei, on the other hand, has witnessed an increase in brand recognition and positive perceptions in recent years, especially in the Chinese market.

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3. Research design and methodologies

3.1 Core concepts and operationalization: smartphone competitiveness

Based on the above analysis, this study takes smartphone competitiveness as the research object and proposes three aspects of competitiveness: supply chain competitiveness (SSC), market competitiveness (MC) and ecological competitiveness (EC). SSC is reflected in smartphone material module, including the supply chain network and production cost; MC is reflected in the global shipment of products, including the ability of standard and sale force. EC is reflected in user experience, including customer retention ability and new customer acquisition ability through software ecology and hardware performances. Therefore, the Smartphone Competitiveness Assessment Model (SCAM) with 33 indicators in three aspects is constructed to deliver smartphone competitiveness (See Table 1).

Table 1: Smartphone Competitiveness Assessment Model (SCAM) with 33 indicators

Competitiveness	Aspects	Indicators
Supply Chain Competitiveness (SSC)	Core chips	System-on-a-Chip (SoC)
		Radio Frequency Chip
		Baseband Chip
		RAM
		ROM
		Power Management Chip
	Other components	Wireless Connectivity Chip
		Printed Circuit Board
		Antenna
		Battery
		Audio device
		Shells
		Display
		CMOS camera
		Optical components
		Wired charger
		Wireless charger
Market Competitiveness (MC)	Shipment	Percentage of shipment by standard
		Growth rate by standard
	5G shipment	5G standard growth rate
		5G Smartphone shipment
		Global 5G shipment
	Predictive factor	Predictive factor
Eco Competitiveness (EC)	Software ecology	Application ecology
		Basic services
	Hardware performances	Signal
		Positioning
		Fast charging
		Endurance
		Camera
		Display
		Audio
		Other Performances

3.2 Model constructing

The SCAM is calculated with three indexes: SSC index indicates supply chain competitiveness, MC index indicates market competitiveness, and EC index indicates eco-competitiveness.

$$SCAM = SSC \times MC^{EC+1} \quad (1)$$

1) SSC index is divided into two parts: "core chip" and "other components". Taking smartphone material module as the unit, the index is built on not only profit margin of the bill of materials (BOM) but also the impact of different decoupling scenarios on chips and components. For non-domestic

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components, the index is calculated on the technology generation gap and the downgrade substitution rate according to Moore's Law. The calculation formula is as follows:

$$SSC = \left(\sum W_{D,i} + \sum W_{N,j} D_j\right) \times P \quad (2)$$

Where $W_{D,i}$ denotes the production weight of localized device i, $W_{N,j}$ denotes the production weight of non-localized device j, D_j denotes the downgraded substitution rate of localized device j, and P denotes the overall profit margin of the smartphone.

2) MC index is divided into three parts: "shipment volume", "5G shipment volume" and "forecast impact factor". Shipment volume indicates the differences in the standard of the smartphone series products shipped using the global 5G smartphone standard growth rate as background. The percentage of 5G shipments represents the impact of the standard on competitiveness. Since the shipment indicator only reflects the situation before the statistical point in time, it does not reflect the real-time changes such as export control, rising shipping costs, upstream supporting stockpiling by enterprises, etc., the model introduces predictive impact factors such as international trade policy restrictions, manufacturing synergy to reflect the smartphone manufacturing environment which may influence the future situation on shipments. The calculation formula is as follows:

$$MC = S_{5G} S_0^{-1} f \quad (3)$$

Where: S_{5G} denotes 5G shipment, S_o denotes shipment, and f denotes prediction factor.

3) EC index is divided into two parts: " hardware performances " and " software ecology". The hardware performance provides scores by professional evaluation. Software ecological indicators emphasize the user experience of application ecology and basic services which correspond to the number of global application developers under the operating system (OS), and the number of meta-API provided by the ecosystem adopted by the smartphone. Based on the limitations of software and basic services with OS, this indicator reflects the user experience at a micro level.

$$EC = 0.1 \sum i_t \quad (4)$$

Where: i_t denotes the performance score of each smart phone.

3.3 Data collection

The data in this research comes from three parts: 1. The data of smartphone materials comes from: Fomalhaut, Jiwei Review, eWish Tech databases; 2. The data of the global smartphone market comes from the databases of IDC, Counterpoint, Strategy Analytics, Digitimes Research, and Trend Force; 3. The analysis data of smartphone hardware comes from GFX Bench, Geek Bench, DXOMARK and etc,.

3.4 Results and analysis

Two representative 5G phones Mate 40 and iPhone 12 are put into the SCAM for analysis. The decoupling scenario are measured in a hierarchical manner to compare the differences in results. Based on realistic trade decoupling scenarios, we combine each technology participant in the supply chain to simulate different levels of possible international trade restrictions. The scenarios are divided into four levels, namely "Decoupling with the U.S.", "Decoupling with U.S.-Japan ", "Decoupling with the U.S.' allies" and "Domestic-made" for Mate 40 while "Global made" for iPhone 12. Therefore, the *SCAM* has a total of four results based on different scenarios (See Table 2).

Table 2: SCAM in four Decoupling Scenarios

	Mate 40				iPhone 12
Scenario / Competitiveness	Decoupling with the U.S.	Decoupling with U.S.-Japan	Decoupling with U.S.' allies	Domestic-made	Global made
SSC	0.357	0.335	0.327	0.317	0.550
MC	2.880	2.880	2.880	2.880	7.200
EC	0.078	0.077	0.077	0.077	0.076
SCAM	1.118	1.046	1.022	0.991	4.598

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In terms of the SSC, Mate 40's SoC and CMOS components are extremely dependent on foreign companies. Due to the limitations of the existing technology, the technology generation gap is large, there is no corresponding substitution, and the downgrade substitution rate is low. Therefore, the phenomenon of "necking" occurs and the supply shortage has a large impact on the production of Mate 40. The difference in the overall profitability between the two smartphones further widened the SSC gap. In the end, the SSC of Mate 40 does not beat iPhone 12.

In terms of the MC, under the Sino-US trade war, the supply chain of SoC chips for Mate 40 was disrupted and the number of chips available for Mate 40 was limited. Due to the shipment shortage, the market share of Mate 40 is profoundly affected and its competitiveness is weakened. iPhone 12's shipment is not affected thus get higher score on MC.

In terms of EC, Mate 40 gets relative advantages on hardware performance by evaluation. As for Google GMS service restrictions, Huawei constantly promote the development of HarmonyOS mobile services with global application developers and the meta-API provided by the ecosystem. Therefore, the EC of Mate 40 is almost comparable with iPhone 12.

In summary, the overall SCAM with 33 indicators in three aspects of Mate 40 does not beat iPhone 12.

4. Conclusion

The analysis of Mate 40 and iPhone 12 using the SCAM with 33 indicators reveals factors affecting smartphone competitiveness. Mate 40 faces notable challenges due to reliance on international supply chains, particularly evident in critical components like SoC chips impacted by trade disputes. However, Mate 40 strides in hardware performance and the software ecology significantly improve its overall competitiveness against iPhone 12. The empirical analysis and future predictions underscore the complexities hindering Huawei's competitive position compared to its global counterparts, signaling ongoing challenges as well as opportunities in the smartphone market.

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