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Innovation around Boundaries: Theory and Applications

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Abstract: In the complex business world, innovation is often subject to various boundaries. Only companies that can innovate under boundary constraints can achieve higher returns than the market average. This article first studies the characteristics and changing patterns of industry boundaries. The first characteristic is that crossing boundaries causes severe consequences. The second characteristic is their ambiguity, which is particularly prominent in emerging industries. The third characteristic is that business boundaries are changing over time. Industry boundaries also present different features depending on the development stage of the industry. In disorder stages, business boundaries are usually loose and ambiguous. In order stages, business boundaries are usually strict and clear. Each industry goes through cycles between disorder and order stages. This article then proposes suggestions for entrepreneurs in different stages to adapt to industry boundaries and respond to boundary changes. When the industry is in disorder stages, companies should focus on rapid growth; when the industry is in order stages, companies should focus on product innovation and differentiated competition.

Keywords: Innovation; Business Boundaries; Industry Development; Entrepreneurship.

1. Introduction

In the 21st century, the business environment has become unprecedentedly complex and uncertain due to the continuous development of technology and consumer demand. Innovation has played a crucial role in various business transformations, for example, the replacement of feature phones with smartphones, or impact of mobile phone applications on traditional consumption scenarios. Innovation is always a critical topic for either long-standing legacy enterprises or young start-ups. Legacy enterprises must maintain their competitiveness through continuous innovation in the ever-changing market and achieve long-lasting success. The value of start-ups lies in innovation, and only through innovation can they establish a foothold in existing markets and create value for the company, customers, and society. How to innovate has become a challenging problem facing countless entrepreneurs.

Given the importance of innovation in business management, many outstanding economists and entrepreneurs have developed numerous innovation theories over the past century. The concept of innovation first appeared as an economic concept in 1912 in the research of Professor Joseph Schumpeter [1]. He defined innovation as a new production function that creatively reorganizes various production factors, and thereby significantly improves operational efficiency at different levels. Another well-known innovation theory, which is more recent, is the theory of "disruptive innovation" proposed by Professor Clayton Christensen [2]. He defined innovation as the emergence of "disruptive technologies", namely technological solutions that are better, more reliable, and cheaper. He conducted in-depth research on the impact of disruptive technologies on industry trends and the rise and fall of big companies, and provided suggestions for identifying and managing disruptive technologies. Due to limited space, there are many other innovation theories that are not mentioned in this paper. All these innovation theories share the similarity in their emphasis on disruptive nature of innovation. That is, the greater the change new technology brings to existing technology, the more likely it beats the incumbent companies and therefore the more likely it is to achieve success.

However, is it true that business innovation is not restricted by any rules? In the contemporary era where various business rules are highly mature, any innovative ideas must develop within certain constraints. The boundaries may be set by legal provisions, social norms or other aspects. Regardless of the source, boundaries play an essential role in business innovations. For example, in manufacturing business, a company must consider production safety first; in food business, a company must prioritize food safety issues. As another example, all companies must avoid false advertising and deceiving consumers. It seems obvious that any company must comply with the laws. However, in many cases, the boundaries faced by companies are not so clear. For example, is it legal for Amazon and Pinduoduo selling counterfeit products of well-known brands? Or can private cars serve customers from online ride-hailing platform (e.g., Uber, Didi), although they do not meet requirements for commercial operations? We find that some entrepreneurs lack a clear understanding of boundaries and rely on the opinions of professionals such as lawyers and accountants, which leads to poor business performance or even being kicked out of the industry. Conversely, other entrepreneurs can identify the boundaries and are good at playing within the boundary constraints, which enables them to obtain higher returns than the market average, while avoiding compliance risks. On the other hand, other entrepreneurs ignore the existence of boundaries or cross the boundaries without thoughtful preparation, which leads to huge risks for the company.

In existing innovation theories, some focus on technological disruptions, some focus on business models, and some focus on organizational change. However, to the best of the authors' knowledge, there is no research that combines innovation with business boundaries in existing literature. This paper focuses on the characteristics and

changing patterns of business boundaries and explores how companies should innovate around boundaries at different stages, in order to get higher profits. We call this theory "innovation around boundaries". The second section of this paper introduces the characteristics of boundaries and summarizes the dynamic changes of boundaries. The third section proposes suggestions for entrepreneurs to adapt to boundaries and to deal with changes in business boundaries. The fourth section summarizes the theory and provides some extension discussions.

2. Characteristics and Dynamics of Business Boundaries

Imagine there is an ancient village that lives by picking wild fruits. For many years, the villagers have only picked fruits within a three-mile radius and never crossed the boundary. Although there are more diverse and lush plants in further regions, there are also fierce wild beasts. No villager knows the specific habits of the wild beasts, and once someone encounters any beast, not only is their life in danger, but the beast may also track their traces to the village, endangering the safety of all villagers' lives and property. As the villagers have been picking fruits within the three-mile radius for many years, the fruits in the safe zone have become scarce and the job has become increasingly difficult. As a result, some villagers think of picking fruits in the outer regions, but are afraid of encountering wild beasts and therefore have not taken any action yet.

This story reflects the features of business boundaries, which can be summarized into three characteristics: severe consequences, ambiguity, and changing over time. Before discussing the characteristics of business boundaries in detail, let us establish a theoretical model of company profits and risks, which will be used to illustrate the theory later.

Figure 1 depicts the profit curve as a company approaches the business boundary. The x-axis represents the company's business scope, and f(x) describes the profit of the company under different business scopes. As shown in the figure, when the company's business scope is far from the boundary (i.e., x<a), the profit is constantly at very low levels. As the company's business scope gradually approaches the boundary (i.e., region a<x<b), the profit rapidly increases. In the real world, the profit curve may not strictly increase monotonically but maintain an upward trend with local fluctuations (see the dashed line in Figure 1). For the sake of theoretical analysis in this paper, we assume that the profit curve f(x) is a concave function that increases monotonically (see the solid line in Figure 1). This assumption does not change any subsequent analysis.

Figure 2 depicts the relationship between the profit and risk of a company, where g(x) is the risk curve for certain business scope. The expected return of the company is the sum of profit and risk, i.e., f(x)+g(x). As shown in the figure, when the company's business scope is far from the boundary (i.e., x<a), the operational risk is extremely low. As the company's business scope gradually approaches the boundary (i.e., a<x<b), though both the profit and the risk increase rapidly, the risk increases faster than the profit. The business scope decision that maximizes overall payoff of the company often appears in this region (see x=x* in the figure).

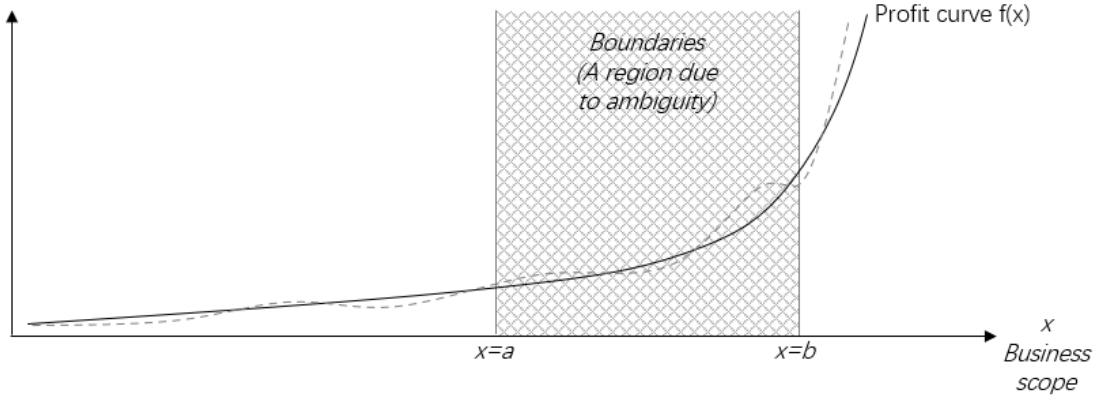


Figure 1. Profit curve as a function of business scope

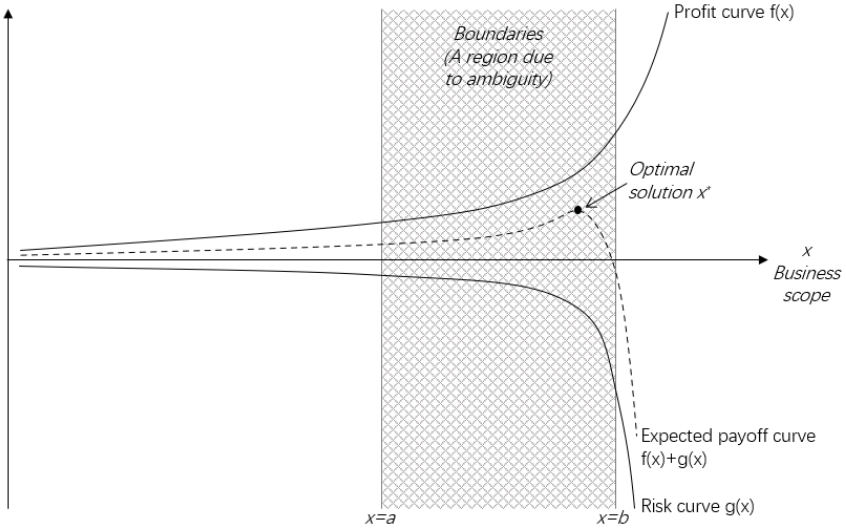


Figure 2. Profit and risk curves of a company

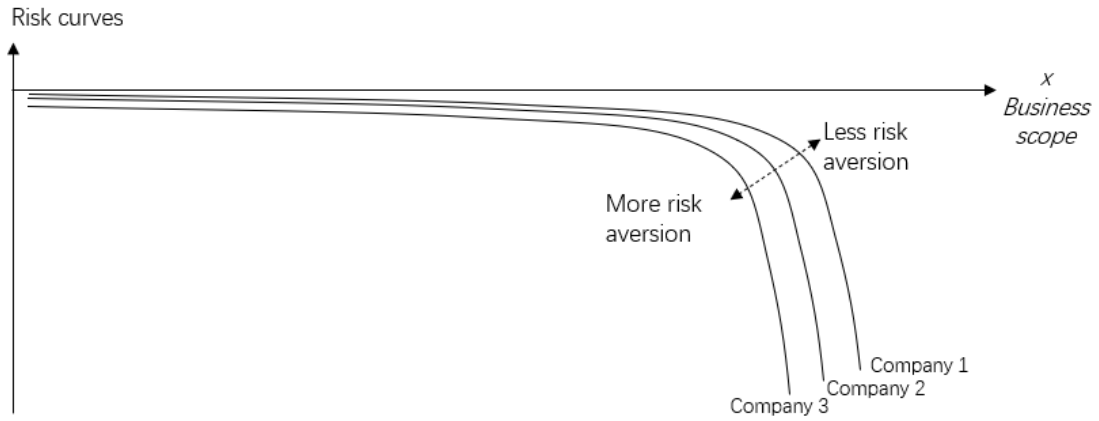


Figure 3. Impact of risk attitude of entrepreneurs on risk curves

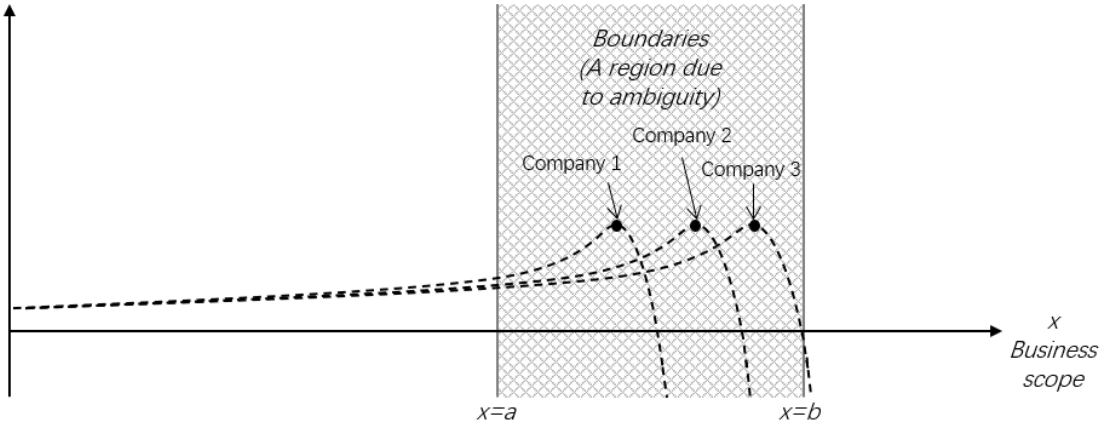


Figure 4. Optimal decision for companies with different risk attitude

It should be noted that even under the same market environment, the expected payoff curve of each company can be influenced by its degree of risk aversion. As shown in Figure 3, let us consider three companies, whose degree of risk aversion decreases from Company 1 to 3. The higher the degree of risk aversion is (i.e., the entrepreneur hates risk more), the greater is the negative utility under the same level of risk in Figure 3. Due to the different risk curves, the expected payoff curves of different companies will also appear in different shapes (as shown in Figure 4). In Figure 4, it can be seen that Company 1 has the lowest degree of risk aversion, so its optimal scope decision is closest to the business boundary (i.e., x=b) in the figure. On the other hand, Company 3 has the highest degree of risk aversion, so its optimal scope decision is farthest from the business boundary.

Next, we will apply the theoretical model described above to analyze the three characteristics of business boundaries.

2.1. Crossing Boundaries Causes Severe Consequences

In our ancient village story, villagers may finally venture into the outer areas to pick wild fruits. However, if they encounter wild beasts, they will not only suffer personal injuries but also endanger the entire village. Similarly, if companies operate near the boundaries for high profits, they also have to take a much higher risk. The first characteristic of business boundaries is that, crossing them may cause severe consequences. Once a company crosses boundaries to pursue higher profit, the risk it faces will increase sharply and it may ultimately have to deal with severe consequences, such as law violation or market punishment.

The 2008 “melamine incident” in China that shocked the world is a good example. The well-known brand Sanlu added the chemical melamine to its raw milk to reduce production costs. After entering the market, the contaminated products caused various health issues to tens of thousands of infants and young children, and even caused multiple deaths due to kidney failure. Sanlu's fraudulent behavior had seriously violated Chinese laws and regulations, and after being exposed and investigated, it received severe punishment by the regulation. Sanlu declared bankruptcy in 2009, and several responsible individuals were also sanctioned by law. However, the impact of the incident was far beyond Sanlu itself. It had a profound impact on China's milk powder industry. During the inspection of leading brands including Mengniu and Yili, it was also found that the melamine content exceeded the standard. After the incident was exposed, Chinese consumers completely lost confidence in domestic milk powder, and many countries stopped importing dairy products from China. The dairy industry fell into a dark period lasting for several years.

The Volkswagen “emissions scandal” is another case that illustrates severe consequences that a company’s misbehavior can cause. In order to pass the emissions test, Volkswagen installed special devices on some models that could recognize the testing scenario and control emissions. However, during normal driving, these devices would not work and the vehicles would emit large amounts of pollutants that far exceeded environmental standards. This behavior was discovered by US regulatory authorities in 2014, and as a result, many countries around the world imposed severe punishments on Volkswagen. The fines and settlements paid by Volkswagen totaled more than 30 billion euros, equivalent to several years of the company's profits.

Therefore, once a company crosses boundaries, although it can obtain high profits in the short term, the business risk also increases sharply, and it may even directly lead to bankruptcy. The management of the company may also face financial penalties or even legal punishment.

2.2. Boundaries are Ambiguous

One may wonder that, are villagers guaranteed safe if they avoid venturing into the remote area? Although everyone knows that there are wild beasts in the remote area, no one can tell the exact locations beyond which wild beasts will appear. And there is certainly no fence or boundary line to clearly indicate the risky areas. The same is true for business boundaries. Many industry standards and even legal provisions have certain degrees of ambiguity in their scope of application and enforcement. The second characteristic of business boundaries is ambiguity. In Figure 2, in theory there is a single optimal business scope (i.e., x* in the figure). However, in the range near x* (i.e., the region where $a < x < b$), both the profit curve f(x) and the risk curve g(x) have some uncertainty, and therefore the optimal solution is not mathematically derived but depends on the judgement of the entrepreneur.

The first reason for the boundary ambiguity is that many regulatory policies are ambiguous themselves in many industries. Especially in emerging industries, most of them will experience a period of relentless growth. In this period, companies often need to deal with ambiguous boundaries. For example, in the early stage of the ride-hailing industry (2012-2016), it is controversial whether ride-hailing companies have the operation qualifications and whether they can ensure passenger safety. Ride-hailing platforms such as Didi believed that companies only provided a non-profit ride-sharing platform that could improve the utilization of social resources. However, many experts and media believed that ride-hailing platforms lacked supervision and were not much different from “black cabs.” Local regulatory agencies in many cities in China even labeled ride-hailing providers as “black cabs” and launched several actions against ride-hailing platforms. Companies such as Didi continued to grow their businesses in such an uncertain environment, exploring a suitable business model, and ultimately became the dominant player in China's mobility market. The legal status of ride-hailing was clarified only until the implementation of the “Interim Measures for the Administration of Online Ride-hailing Services” in 2016

Even if the regulatory policies are clear, the implementations in different regions may still vary, which in fact results in boundary ambiguity. We continue to take the ride-hailing industry as an example, after the “Interim Measures for the Administration of Online Ride-hailing Services” became in effect, many cities issued detailed implementation rules. Beijing's rules included requirements such as that the driver must be a Beijing resident, the operating vehicle must have a wheelbase not less than 2650 mm and an engine not smaller than 1.8 liters. However, the rules were not fully enforced, and there were still many drivers or operating vehicles that did not comply with the rules in the market. The implementation force was also different in individual areas, and in different time periods of a day. For example, the implementation force is generally stricter in crowded places such as airports and train stations than other areas. It is also stricter during rush hours than that of other time periods. Ride-hailing platforms and drivers continued to operate in such a regulatory environment that was sometimes strict and sometimes lax.

Besides the ride-hailing industry, many other emerging industries, such as e-commerce, internet brokerage, digital currency, and e-cigarettes, face exactly the same challenge of ambiguous boundaries in their early stages.

2.3. Boundaries Change Over Time

In the ancient village, is the area where wild beasts appear always the same? Obviously not. Various factors may lead to changes such as climate change, animal migration, and birth and death. In the long period of company development, business boundaries are also constantly changing. As seen in Figure 2, the area near the boundary will change over time. That is, the values of a and b will shift around. Changes in the boundary directly affect the profit curve f(x) and the risk curve g(x), thus impact the optimal decision.

Boundaries change in two dimensions: the first is a spectrum between loose and strict boundaries, while the second is a spectrum between ambiguous and clear boundaries. In the early stages of an industry’s development, players typically operate under loose and ambiguous boundaries. Products, business models, consumer acceptance, and regulations all quickly evolve. This stage is called the "disorder" stage of an industry. As the industry develops, products and business models become established, consumers become mature, and regulations become clearer and more standardized. Meanwhile, the business boundaries will also gradually evolve towards strict and clear ones. This stage is called the "order" stage. Even in order stages, products, technologies, and consumer needs are still constantly changing. Once a breakthrough innovation happens, the industry structure will be disrupted, and it will enter next disorder stage again.

It is worth noting that during disorder stages, although business boundaries are loose, it does not mean that there is no boundary. Companies still need to comply with certain rules in the market. In order stages, although business boundaries are relatively clear, they still have some degree of ambiguity. Companies that can study and understand business boundaries can gain stronger market competitiveness.

Each industry goes through a cycle of disorder and order stages, despite the length of each stage may largely vary. In this cycle, companies who can anticipate and respond to boundary changes with innovative and appropriate strategies can achieve higher returns. On the other hand, companies that ignore or misjudge boundary changes will face serious constraints on their growth: they may either only achieve lower-than-average returns or take too much risk. In the next section of this paper, we will discuss strategies that companies can adopt at different stages to address boundary changes.

3. How Entrepreneurs Innovate around Boundaries?

Business boundaries and their changing trends have a great impact on business operations. Firstly, entrepreneurs should identify the current development stage of their business and boundaries they are facing. Regardless of whether in disorder or order stages, entrepreneurs need to take appropriate actions based on the current state and trend of the boundaries in their industry. In disorder stages with loose and ambiguous boundaries, business operations have greater flexibility. The strategy should focus on growth, through either independent

operations or cooperation with incumbent players to quickly seize the market. Meanwhile, as the disorder stage evolves into the order stage, companies need to foresee changes in business boundaries and plan their business strategy in advance. In order stages with strict and clear boundaries, business operations will be subject to various constraints. Companies should first emphasize on cost control and efficiency improvement to obtain competitive advantage. At the same time, innovation should be the main driving force for future growth. Through technological or business innovation within existing business boundaries, companies may find new markets and gain excess profits.

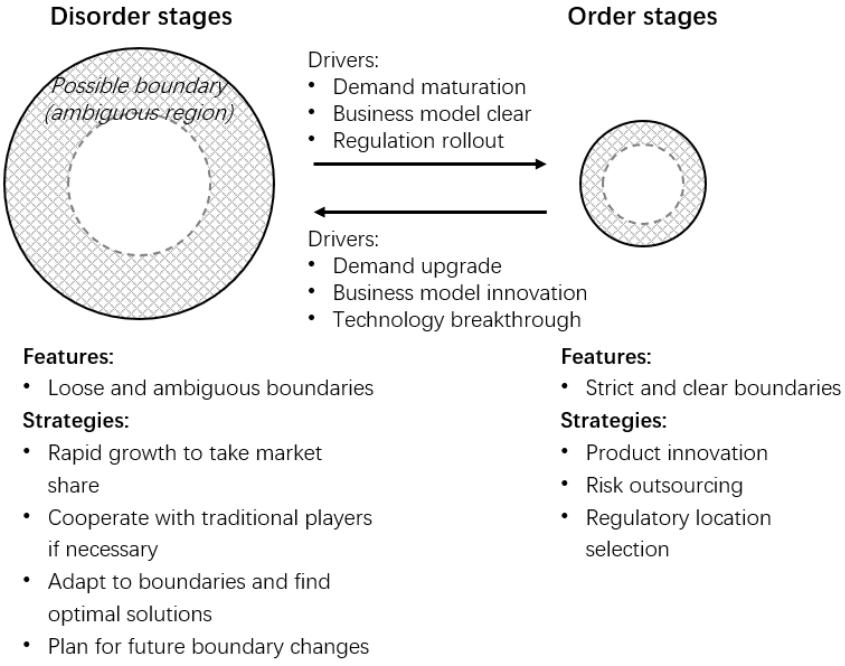


Figure 5. Optimal decision for companies with different risk attitude

3.1. Identify Business Boundaries

In addition to the laws and regulations of each country, the boundaries of different industries often differ greatly. Companies need to identify business boundaries of their own industry in order to make right business decisions. The business boundaries are typically set by laws and regulations, ethical conventions, national culture, religious customs, and other aspects.

3.1.1. Boundaries from Laws and Regulations

In both disorder and order stages, companies must comply with laws and regulations in their countries. As the old saying goes, "all quick money-making methods are written in the criminal law." The food processing industry needs to comply with food safety-related laws, manufacturing companies need to comply with production safety and environmental protection-related laws, and financial institutions need to comply with financial regulatory-related laws. The "melamine incident" and "Volkswagen emission scandal" mentioned earlier are examples of companies being severely punished for breaking the laws. In disorder stages, industry boundaries are mainly based on general laws and regulations, such as the Consumer Rights and Interests Protection Law, the Food Safety Law, the Environmental Protection Law, etc. In order stages, companies not only need to comply with general laws and regulations but also must comply with specific industry regulations. For example, ride-hailing platforms need to comply with "Interim Measures for the Administration of Online Ride-hailing Services" and various detailed rules and policies in different local regions.

3.1.2. Boundaries from Ethical Conventions

In addition to laws and regulations, companies should also consider ethical conventions as important business boundaries. The scope of ethical conventions is wider than that of laws and regulations, including integrity in business, fairness and justice, and diligence and self-improvement, and many others. Falling to follow ethical conventions may not be punished by laws, but it can have a significant negative impact on brand image and consumer recognition. The damage to a company may be even larger than that of violating laws and regulations.

The Samsung "battery incident" is an example in which breaking the ethical conventions brings severe punishment. In 2016, Samsung's latest flagship smartphone Galaxy Note 7 suffered from battery defects and caused multiple incidents of self-ignition and even explosions worldwide, posing a serious threat to consumer and public safety. After the incident, Samsung quickly announced the global suspension of sales and recalled problematic phones. However, the China market was not included in the recall, and the official reason was that the products sold in the China market used different battery suppliers and did not have any risk of explosion. However, only shortly after Samsung's announcement, multiple incidents of self-ignition or explosion occurred in China market. Despite that the Chinese regulatory authorities immediately started investigating on Samsung, Samsung announced a recall plan for the China market only 2 months later. Although Samsung's behavior was not illegal, its unfair recall policy caused great complaints among Chinese consumers. The incident enforced Samsung's decline in the China market. Before the battery incident, Samsung's market share in the China smartphone market already fell to 7-8% from over 20%. Within just 2 years after the battery incident, its market share dropped to below 1%.

3.1.3. Boundaries from Cultures and Religions

For companies operating in multiple countries or in multi-ethnic areas, lack of attention on local cultural or religious

customs can often result in huge losses. For example, when Xiaomi entered the Japan market in 2019, it released a marketing video. In the video, a person inflated into a fat man and eventually exploded, forming a mushroom cloud. The intention was to highlight the feature of fast charging of Xiaomi smart phones. However, many Japanese consumers linked this video to the atomic bombs dropped in Japan in World War II, one of which was called "Fat Man." As a result, Japanese consumers felt insulted, and they protested against Xiaomi products. In the end, Xiaomi had to withdraw the video and apologize to Japanese consumers.

Another example about religious customs is pork-related business in Muslim regions. According to Islamic ethics, Muslims cannot have pork or pork-derived food. There are many areas in the world where Muslims and other people live together. Improper package or sales of pork products can often offend Muslims, and therefore cause troubles to the business. In fact, many protests or even conflicts actually happened due to the sales of pork or pork dishes in supermarkets or restaurants in multi-religion areas. The lessons are that once a company crosses boundaries of religious customs, it will not only face operational disturbances but may also get involved into religion conflicts.

3.2. Strategies in Disorder Stage: Grow Fast

In disorder stages, a company's main goal is to grow and capture market share relentlessly. Meanwhile, it must also keep an eye on business boundaries and their trends.

3.2.1. Grow Fast

In disorder stages, business boundaries are loose and ambiguous, with little constraints on business operations. Disorder stages often appear in the early time of industry development, and there are usually many competitors entering the market. Therefore, companies should do everything possible to achieve rapid growth and become market leaders. In disorder stages, companies have greater flexibility in operations and can adopt multiple growth strategies. Once the market enters order stages, business boundaries become strict and clear, and it becomes difficult to achieve rapid growth.

In many emerging industries, leading companies have gained their position in the disorder stages. For example, dockless bike-sharing services, represented by Ofo and Mobike, started to operate in 2014 to 2015. Before that, the mainstream bike-sharing services were docked bikes offered and managed by the government. Dockless bike-sharing was an industry innovation, with great ambiguity in both business model and industry regulations. In this environment with loose and ambiguous boundaries, bike-sharing companies quickly seized the market by deploying a vast number of bikes, frequent advertising campaigns, incentives for new users, and free rides. In the early stage, service providers were bothered by quite a few problems, such as abuse of public resources, high damage and loss rates, etc. Despite of these problems, all players still focused mainly on user growth. In just three years, dozens of bike-sharing brands emerged in China, with a total deployment of over 20 million bikes. Mobike and Ofo held the market leading position, with combined market share of approximately 90% in 2017. Two important changes in 2017 to 2018 marked the turning point of bike-sharing industry from the disorder stage to the order stage. First, the business model became clear. Only top players with significant scale benefits had the chance to profit, while medium and small brands quitted from the market. Second, industry regulations were introduced. In August 2017, China government issued the "Guidance on Encouraging and Regulating Bike-sharing Industry," with detailed regulations on the number of bikes, riding insurance, electronic parking fences, deposit management, information security, etc. Thus, the rapid expansion stage of the bike-sharing industry reached to the end, and only a handful top players survived and continued to compete in the market.

Many industries require government authorization to participate in the playground, and it may take years to get the permit. To innovate in these industries, a company shall cooperate with licensed companies to enter the market first to achieve rapid growth. The company can simultaneously apply for authorization, and switch to independent operations when it is done. For example, media industry is normally subject to strong regulations. When internet media (e.g., Yahoo! and Sina) first appeared in China around 2000, they were not authorized to collect, edit, and publish news independently. As all the internet services were rapidly expanding in this period, internet media companies also quickly occupied the market by cooperating with traditional media, and grew to the leading portal websites. The electric vehicle industry also illustrates the cooperation between traditional players and new entrants. In China, it is quite difficult and lengthy to obtain a license for passenger vehicle production. Most emerging electric vehicle manufacturers chose to work with traditional vehicle OEMs, and quickly brought their products to market. For example, NIO worked with JAC Motors for contract manufacturing, and Li Auto worked with Lifan Motors for contract manufacturing. Some electric vehicle manufacturers even acquired traditional OEMs to obtain both the license and plants for production. For example, WM Motor acquired HuangHai Auto. In summary, these companies quickly captured the market share in the disorder stage, and took a good position for future growth.

3.2.2. Adapt to Boundaries

In disorder stages, although business boundaries are loose and ambiguous, it does not mean that there are no constraints. In such business environment, a company should stand close enough to boundaries to gain competitive advantage, but not breaking them. How can a company adapt to business boundaries? The answer is investing to reduce the ambiguity of boundaries. For example, hiring industry experts and legal advisors can provide a more accurate interpretation of ambiguous regulatory policies. Some companies can even participate in the policy-making process through political lobbying, and thereby influencing industry boundaries. As a result, different companies have significantly different perceptions of boundaries. Some companies have a relatively clear understanding of boundaries, while others are still completely puzzled. Therefore, companies with clearer understanding can leverage its knowledge to capture higher profits. Research and judgment of business boundaries is actually one of the core competencies of a company.

During the early time of the ride-hailing industry, the legal status of such services was questioned by many people. Some companies simply stopped their operations to avoid risks but also missed the trillion-dollar opportunity in this industry. Others decided to run the business with a fleet of fully self-owned vehicles. Due to high capital requirement and slow expansion, they also failed to become top players. Only companies like Didi persisted in exploring the platform business model and eventually succeeded. Didi went public on the NASDAQ in 2021, nine years after its establishment.

However, after its IPO, Didi was investigated by seven Chinese government departments for allegedly endangering national data security. A year later, the investigation concluded, and Didi was fined 8 billion yuan for violating several laws, including the Cybersecurity Law, Data Security Law, and Personal Information Protection Law, and etc. Since the start of investigation, Didi was forced to remove its mobile app from major app stores and stop accepting new user registrations until early 2023. In this incident, Didi completely misjudged the boundary of its business and received severe punishment.

3.2.3. Predict and Plan for Boundary Shift

In disorder stages, business boundaries changes over time. Therefore, companies not only need to adapt to boundaries, but also need to pay attention to the trend of the shifting boundaries. Boundary changes often have a significant impact on the future evolution of the business. Companies need to adjust their strategies and prepare for the future based on their judgment of boundary changes. The history of cryptocurrency perfectly shows boundary changes. In 2011, China's first virtual currency exchange, BTCC, was established. With the skyrocketing price of Bitcoin, BTCC also experienced its glorious moment: its trading volume once accounted for 80% of China's digital currency trading volume, far ahead of its competitors. In September 2017, the People's Bank of China and six other departments jointly issued the "Announcement on Managing Risks of Initial Coin Offerings," which clearly defined ICO as illegal and stopped any business related to cryptocurrency trading. Like most exchanges in China, BTCC immediately closed its trading platform in China and sold the company to a Hong Kong-based fund in January 2018. Although BTCC, under new ownership, continued its international business, the trading volume was much smaller than before, so was its global influence. In contrast, Binance, established in 2017, envisioned that the Chinese regulation would tighten and decided to move from China to Japan only two months after its establishment. After years of global development, Binance eventually became the world's largest currency exchange.

Through the above discussion and cases, we conclude that in disorder stages, identifying, understanding, and adapting to business boundaries plays a key role for a company to succeed, as well as predicting and being prepared for boundary changes.

3.3. Strategies in Order Stage: Differentiation by Innovation

In order stages, business boundaries become strict and clear. An industry often experiences a trend of increasing concentration, and a large number of companies are eliminated by market competition. The surviving companies need to operate under strict boundary constraints. Strict boundaries lead to product homogenization, making it difficult for companies to obtain higher-than-average returns. However, clear boundaries are relative to disorder stages, and do not necessarily mean that business boundaries are 100% certain. Therefore, companies that are operating close to boundaries through innovative approaches can still gain a differentiated advantage.

In order stages, as companies have limited flexibility under boundary constraints, innovation is more challenging. We have observed numerous cases of companies that have successfully innovated around boundaries in order stages, from which we summarized a few patterns that many great companies adopt. They are product innovation, risk outsourcing, and regulatory location selection.

3.3.1. Product Innovation

In order stages, products in competition are usually highly homogenized. Product innovation is the most common approach to break that homogenization. If innovative products are more attractive to consumers (cheaper, easier to use, better performance, etc.) but still within the business boundaries, it can gain more market share and higher profits. For example, in the electric vehicle industry, low-speed four-wheeled electric vehicles are a successful product innovation. Low-speed four-wheeled electric vehicles capture the demand for scenarios such as patrol, sightseeing, and short-distance transportation, featuring on easy operation and low cost. Driving them in certain areas of China (mostly rural areas) does not even require a license or vehicle registration. Low-speed four-wheeled electric vehicles have been widely accepted by consumers, with over one million annual sales. Despite of its convenience and low cost, there are also risks that endanger drivers and public safety, such as lack of car quality assurance and improper operations. Regulatory authorities have already noticed this issue, and are working on regulations.

Some product innovations can even create a new industry. The online ride-hailing industry discussed earlier is an example where companies like Uber and Didi have created a new sub-industry within the traditional taxi industry through technological innovation. Similarly, electronic cigarettes are innovations based on the traditional cigarette industry. Although these innovative products serve the same consumer needs as traditional products, the difference between them is so large that existing business boundaries are no longer applicable to the new industry. In this case, the new industry enters the disorder stage and starts a new cycle.

3.3.2. Risk Outsourcing

Under strict boundaries of order stages, companies may strip off and outsource their higher-risk business activities to other companies in the value chain. In this way, they can meet consumers' demands without bearing operational risks. Companies that are willing to take risky activities are often small businesses or even individuals, as they are relatively flexible in terms of regulations due to their small scale, and may even enjoy benefits from incentive policies for small and micro businesses.

Let's discuss cryptocurrency as an example. Cryptocurrency trading can be categorized into coin-to-coin trading (i.e., trading between two cryptocurrencies) and fiat currency trading (i.e., trading between cryptocurrencies and fiat currencies). Investors need to convert fiat currency into cryptocurrency at the beginning of trading, and investment returns ultimately need to be converted back into fiat currency. From the perspective of exchanges, the risk of fiat currency trading is higher than coin-to-coin trading. On the one hand, fiat currency trading is subject to the laws and regulations of various countries, and banks provide limited access to cryptocurrency trading, making it difficult to operate fiat currency exchange. On the other hand, if exchanges support fiat currency trading, they need to reserve a large amount of cash in multiple currencies, significantly increasing operational costs and potential risks. Therefore, mainstream exchanges only engage in coin-to-coin trading, while fiat currency trading is conducted directly between users themselves. By this way, exchanges avoid the high costs and operational risks associated to fiat currency trading.

To certain degree, platform strategy is also risking outsourcing. For example, on e-commerce platforms like Amazon and Pinduoduo, false advertising, counterfeit products, are not uncommon. Although the platform or regulatory authorities sometimes penalize such sellers, Amazon and Pinduoduo, as platform operators, are rarely impacted. Moreover, due to the large number of sellers, it is difficult for either platforms or regulatory authorities to implement strict control. The platforms also benefit from these sellers, as they cover the users in lower-end markets. If e-commerce players were to sell these products by themselves, they would likely be investigated by regulatory authorities. However, adopting a platform strategy transfers this risk to millions of small sellers, ensuring that the platform's own operations comply with regulations.

3.3.3. Regulatory Location Selection

In industries where business boundaries are strict and primarily driven by regulations, companies can consider relocating to regions with more friendly regulations. Similar to economic development, the stage of regulatory development also varies a lot in different countries around the world. When an industry in a certain region already has strict regulatory boundaries, companies can explore other locations, especially developing countries to see if there is still a flexible regulatory environment. For example, after 2017, Chinese online P2P lending platforms faced increasingly strict regulations. The market also became saturated, with profit margins continuously shrinking. Under such circumstance, many P2P platforms began to expand overseas as early as 2016, mainly targeting Southeast Asian and Indian markets. By around 2020, regulations in Southeast Asia and India also tightened. These companies again shifted their market focus and moved to South America and Africa to expand their business.

In addition to the inconsistency of regulatory development, different countries or regions also have varying preferences for even risky industries. Many countries with a focus on offshore economics have higher tolerance for high-risk businesses, making them preferred registration locations for companies with high-risk activities. For example, although cryptocurrency exchanges are prohibited in many countries, they are completely legal in offshore countries such as Malta and the Bahamas. As mentioned earlier, after leaving China, Binance first settled in Japan and then moved to Malta within the same year. Regardless of its registration places, Binance is able to serve global customers with its strong internet product capabilities. A suitable regulatory location is particularly attractive for internet companies that do not involve physical delivery, as these companies have the ability to serve global customers and their service capabilities are not impacted by their place of registration. It is important to note that internet business operations should also comply with the laws of the customers' countries as much as possible in order to achieve long-term development.

4. Summary and Extensions

In the complex and ever-changing business environment of the new era, business innovation is more or less constrained by business boundaries. The “innovation around boundaries” theory proposed in this paper elaborates on the relationship between business innovation and business boundaries.

This paper first studies the characteristics and changing patterns of business boundaries. The first characteristic of business boundaries is that crossing boundaries causes severe consequences. If a company breaks business boundaries in pursuit of high profits, it often faces legal or market penalties and suffers from serious consequences. The second characteristic of business boundaries is their ambiguity, which is particularly prominent in emerging industries. The ambiguity of boundaries stems from multiple aspects, such as the vagueness of regulatory policies, regional differences, and the uncertainty of social concepts. This ambiguity makes it impossible for entrepreneurs to accurately make the optimal decisions for their business operations. The third characteristic is that business boundaries are changing over time. Depending on different stages of industry development, business boundaries can move in the spectrum of being loose and strict, as well as in the spectrum of being ambiguous and clear. In disorder stages, business boundaries are usually loose and ambiguous. In order stages, business boundaries are usually strict and clear. Each industry goes through cycles between disorder and order stages.

This paper also studies how successful companies and entrepreneurs respond to business boundaries. First, entrepreneurs must identify the current stage of the industry in which they play, and identify the boundaries. In addition to laws and regulations, business boundaries often come from various aspects such as moral conventions, ethnic cultures, and religious customs. Only by deeply understanding the current state of business boundaries can companies make correct decisions. In disorder stages, a company's strategy should focus on rapid growth. Companies that gain first-mover advantages usually have a higher probability of success. In disorder stages, business boundaries change relatively quickly. Companies need not only to adapt to boundaries but also to anticipate the changing trends of boundaries and make plans in advance. In order stages, the company's strategy should primarily focus on innovation and differentiated competition. The first strategy is continuous product innovation. If a new product can satisfy boundary constraints while being more attractive to consumers, it can obtain excess returns. In addition, risk outsourcing and regulatory location change are also common innovation strategies in order stages. In conclusion, in either disorder or order stages, deeply understanding the constraints of business boundaries, constantly innovating to find the optimal solution, anticipating changes in business boundaries, and planning ahead are the sources of companies obtaining excess profits above industry average.

At the end of this paper, we discuss three extensions about the theory of “innovation around boundaries:” the role of entrepreneurship, the implications for regulators, and applications in non-business fields.

4.1. The Role of Entrepreneurship

Although this paper discussed the characteristics and patterns of business boundaries, as well as typical strategies to manage boundaries, all discussions are guiding principles rather than a one-size-fits-all solution that guarantees success in business innovation. The inherent ambiguity and variability of business boundaries make even seemingly reliable innovations fraught with uncertainty. For example, the theory suggests predicting trends in boundary changes and making business arrangements accordingly; however, there are numerous cases where companies have been eliminated from the market due to mistakes in their predictions. Similarly, the theory proposes obtaining above-average industry profits in

order stages through product innovation, but failed product innovations far outnumber successful ones. Therefore, despite having some theoretical guidance, achieving a competitive advantage through innovation around boundaries still requires entrepreneurs to make decisions based on their own judgment. It is crucial for entrepreneurs to consider the unique context of their industry and business and adapt the principles to suit their specific needs and challenges, rather than blindly following a predetermined formula.

Professor Zhang Weiying, the renowned economist, offers brilliant insights into the relationship between innovation and entrepreneurship in his book "Rethinking Entrepreneurship." [3]. Innovations are often challenged by significant uncertainties in technology, business, and policy. Many great innovations were not well recognized in their early stages. However, entrepreneurial decision-making is not totally scientific based on data and calculations. It is also based on imagination, intuition, and judgment. Therefore, the success of great innovations cannot be separated from the support of entrepreneurship. From this perspective, the success of innovation around boundaries is also closely linked to entrepreneurship. The theory discussed in this paper is intended to provide some inspiration and guidance to entrepreneurs and increase the chance of success, rather than to give a step-by-step prescription.

4.2. Implications for Regulators

Government regulators play a crucial role in both disorder and order stages. Understanding this theory about business boundaries helps regulators design and implement policies in different industries and stages, thereby maximizing overall social benefits.

In disorder stages, industry development requires a relatively relaxed regulatory environment, which stimulates the enthusiasm of entrepreneurs to innovate. Overly strict regulations can hinder industry development and even stifle emerging industries. However, lack of regulations can also lead to disorderly expansion and create systemic risks. Therefore, as government regulators, it is essential to strike a balance between strict and relaxed regulatory environment and make continuous adjustments according to industry development.

In disorder stages, regulators may adopt somewhat vague policies. In disorder stages, new technologies or new business models often bring significant changes to existing industries. Regulators also need time to learn and adapt. Therefore, the industry will experience a gradual evolution from no regulation to vague regulation, and then to clear regulation. A certain degree of ambiguity gives some flexibility to government regulators, allowing them to adjust and improve policies according to the development of the industry.

4.3. Applications in Non-business Fields

The principles related to boundaries in the theory are applicable to not only the business field, but also many non-business fields. Some controversial topics are whether more advanced technology is always better, whether scientific research should be subject to boundary constraints, and etc. They have attracted wide attention from many scientists and even the entire human society. For example, after the invention of nuclear weapons, humans realized that they could potentially destroy humanity. Therefore, the international community has imposed a series of restrictions on the research and use of weapons of mass destruction to prevent individual countries from crossing boundaries and causing catastrophic damage to the entire human society. Another example is scientific research in the field of artificial intelligence. Although current evolution of artificial intelligence is still in its early stage, people have already enjoyed the enormous conveniences in both production and daily life. Technologies such as intelligent robots, autonomous driving, and facial recognition based on artificial intelligence have been widely applied. On the other hand, as artificial intelligence technology continues to mature, many scientists have raised concerns: will the excessive development of artificial intelligence technology cause humans to become overly dependent on machines, leading to humans' degradation of independent thinking and action? Will robots with autonomous consciousness pose a threat to humans? Renowned scientist Stephen Hawking was one of them, and he once predicted that if artificial intelligence were to be developed without restrictions, once robots were out of human control, they would threaten human survival. Within the framework of "innovation around boundaries," humans need to constantly think about the boundaries of scientific and technological development and seek the optimal solution for human survival and development under uncertain and ever-changing boundary constraints.

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