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MARKET STRUCTURE AND COMPETITIVE BEHAVIOR OF THAILAND'S CANNABIS CULTIVATION INDUSTRY

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Abstract

The legalization of cannabis for medical and industrial use in Thailand in 2019 sparked growth in the cannabis cultivation sector. This transformative shift led to changes in market dynamics, influencing the industry's competitive behavior. This study examines the market structure and competitive behavior of Thailand's cannabis cultivation sector from 2019 to 2021, post-decriminalization. It assesses the market structure, focusing on the industry concentration and competitive dynamics, using the Herfindahl-Hirschman Index (HHI) to quantify cannabis cultivation area concentration. Results show an annual increase in the number of market firms, notably in 2021, with community enterprises surging by 291 since 2019. Cannabis cultivation expanded across all regions, indicating heightened market competition, and midstream-downstream industries were significantly related to cannabis farm presence in each district (P-value 0.004). HHI analysis reveals an average of 3,259.23 from 2019 to 2021, identifying a deconcentrated market in 2021, with increasing competition rates yearly. Findings suggest market behavior characterized by rising competition, expanding firms—especially community enterprises—and widespread cannabis cultivation farm distribution nationwide.

Keywords: Cannabis Cultivation, Competitive Behavior, Market Structure, HHI

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Introduction

Cannabis cultivation has gained substantial economic and societal significance, shaping revenue streams, creating employment opportunities for professions aligned with the cannabis industry, and influencing policy landscapes (Kelly & Formosa, 2020; Yeoh, 2020). This industry has triggered substantial regulatory shifts globally, leading to the redefinition of legal frameworks and the transformation of market dynamics (Wanke et al., 2022). However, these developments have also had economic and societal repercussions, such as increased crime rates (Johnson et al., 2017) and heightened youth access to cannabis (Dills et al., 2021). Therefore, advocacy efforts must consider these issues when pushing for policy changes.

Thailand, like several other countries, explores the potential benefits of utilizing cannabis, encompassing both therapeutic Cannabidiol (CBD) and Tetrahydrocannabinol (THC). In 2019, Thailand underwent transformative legislative changes, embracing cannabis for medical and industrial applications (Narcotics Act No.7, 2019), which had ushered in a substantial expansion of registered cannabis cultivation sites (Bednarek et al., 2022). Thai Food and Drug Administration data reveals that by 2021, the cumulative cultivation area exceeded 87,632.62 square meters, an increase from the 10,944 square meters recorded in 2019 (Thai Food and Drug Administration, 2022). Dynamics in market changes from 2019 to 2021 have impacted the market structure and competitive behavior of the cannabis cultivation industry (Zinboonyahoon et al., 2021).

Thailand's policy evolution regarding cannabis closely resembles that of countries such as Uruguay and Georgia, focusing primarily on medicinal use rather than recreational consumption. This strategic approach aligns with global trends towards the legalization of medical cannabis, aiming to capitalize on economic opportunities while safeguarding public health and regulatory integrity.

Therefore, this study investigates the dynamics of market concentration, characteristics, and growth of Thailand's cannabis cultivation industry. The Herfindahl-Hirschman Index (HHI) serves as a crucial tool for measuring competition concentration and conducting market structure analyses (Rhoades, 1993). This index, prominently featured in various studies (Chou et al., 2011), is well-suited for assessing the dynamics of competition. Its widespread use in cannabis studies, as noted by Bednarek et al. (2022), further underscores its applicability.

This study aims to deepen understanding of market dynamics and provide insights for future operational strategies in Thailand's cannabis industry, mitigating market uncertainties and maximizing long-term benefits for the country. The study explores the industry's scope and development from 2019 to 2021, analyzing market transformations and competitive behaviors. Additionally, it examines the relationship between the cannabis industry, midstream-downstream sectors, and cannabis farms.

Literature Reviews

Market Structure

Market structure serves as a crucial economic tool for understanding market organization characteristics and changes. Analyzing market structure is essential in comprehending the dynamics of market evolution. In the study of market structure, industry concentration is commonly employed to measure market competitiveness. This index, often utilized to gauge the number of firms and production capacity within each industry, can be assessed through a concentration ratio (Tirole, 1988). The assessment of market concentration holds crucial importance for various stakeholders, including investors, consumers, and regulatory bodies. Investors, in particular, attach significance to the degree of concentration as it affects factors such as market entry barriers, market volatility, and pricing mechanisms. One straightforward method for gauging industrial concentration is by tallying the number of competitors operating within a specific industry (Akomea & Adusei, 2013).

Understanding market structure is essential to comprehending the intricate factors influencing market dynamics (Caves & Porter, 1978). It allows us to explore the behavior of market participants and evaluate the consequences of policy decisions market share are used in a number of contexts to measure how the status of the market. Several indices have been proposed in the literature and have been applied in the market of agricultural products Among them, two have emerged as the most widespread: market share (Armstrong, 2021; Bednarek et al., 2022) and the Herfindahl-Hirschman Index (HHI) (Giroldo & Hollenbeck, 2021; Caulkins et al., 2018)

Herfindahl-Hirschman Index (HHI) for Analyst Market Concentration

The HHI is a widely used statistical measure for determining the level of concentration (Rhoades, 1993). It is a component of the antitrust policy of the United States since 1982 and is one of the most extensively used indices globally for evaluating market concentration (Hirschman, 1945; Herfindahl, 1950).

The HHI indices have been used to study the structure of the cannabis industry in other countries. Caulkins et al. (2018) used HHI to analyze the competition of the legal cannabis market in Washington for processors and retailer's firm. Several other studies have also utilized the HHI for competition analysis, such as Giroldo & Hollenbeck (2021) have also employed the HHI for competition analysis. This study specifically studied the causal link between market concentration and markups in a cannabis retail setting in Washington. Their findings revealed that concentrated markets have significantly lower markups and wholesale prices, indicating a highly competitive nature in the cannabis market.

This index could be support in the context of cannabis cultivation, market structure analysis enables us to analyze how business size, and market dynamics affect the spatial distribution of cultivation areas (Hammersvik et al., 2012).

To assess the market structure, we deploy a pivotal index, the Herfindahl-Hirschman Index (HHI). Widely utilized in economic studies, these indices play a crucial role in measuring market concentration within Thailand's Cannabis Cultivation Industry from 2019 to 2021. Our focus is on identifying the type of market and provinces with high concentration, as well as pinpointing dominant firms in the market.

Dynamics of the Market under New Market Entries

The growing cannabis cultivation industry in Thailand is evident through the increasing number of market firms (Thai Food and Drug Administration, 2022). This surge in New Market Entries directly impacts market competition positively (Bresnahan & Reiss, 1991).

As the number of firms in the market rises, competition intensifies (Haveman & Nonnemaker, 2000), as observed in previous studies (Alvarez et al., 2016) which delved into cannabis cultivation in Spain. In their analysis, they presented insights into the types of cultivation areas, participant details, production systems, and the distribution patterns at a regional level. The study concluded that the rise of large-scale cannabis plantations has led to the expansion of cultivation areas and increased competition within the industry.

In the context of the literature review, the mention of "New Market Entries" signifies an acknowledgment of evolving dynamics within Thailand's cannabis cultivation industry. The influx of new firms is expected to influence market competition and structure significantly. Analyzing the impact of these entrants using metrics such as the HHI can illuminate how market concentration and competitive dynamics evolve over time for the conceptual framework of this study which can be drawn as shown in Figure 1.

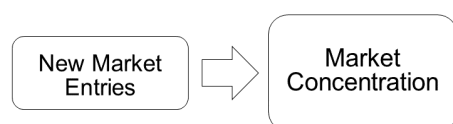


Figure 1 Conceptual Framework of the study

To elaborate on the conceptual framework, this study aims to explore the interplay between new market entries, market competition, and industry dynamics. By examining these elements, we seek to provide a comprehensive understanding of how the cannabis cultivation sector in Thailand adapts to new market conditions and regulatory environments.

Research Methodology

This section outlines the methodologies employed to analyze the context Thailand's cannabis cultivation industry. This study uses quantitative research with data from the Thai Food and Drug Administration (FDA) as its basis. We use descriptive statistics to categorize registered firms and cannabis cultivation areas, provide details about the utilization of cannabis and illustrate the distribution of products across various regions. Additionally, we analyze the market structure using the Herfindahl-Hirschman Index (HHI) with a specific focus on identifying clusters within the cannabis cultivation area. These methods are essential for examining market competitiveness, market concentration and dynamics of the market in Thailand's cannabis cultivation industry.

In addition to descriptive statistics, we employ inferential statistics by analyzing cannabis industry boundary relationship for midstream-downstream with cannabis farms in earth area. We using Fisher's exact test to evaluate the associations between the cannabis industry, midstream-downstream sectors, and cannabis farms to identify the relationships among stakeholders at the district level in Thailand.

Data Collection and Data Analysis

The study is based on secondary data collected from the Ministry of Public Health. the Narcotics Control Division of the Thai Food and Drug Administration (FDA), a governmental body, oversees the registration and supervision of cannabis cultivation (Narcotics Act No.7, 2019). These datasets encompass vital aspects of Thailand's cannabis industry from 2019 to 2021, including specific details about 342 cannabis cultivation sites. The data used in the study includes production capacity, registration, and farm location information. Additionally, the researchers utilized transaction data of cannabis sales to consumers in the midstream and downstream industry sectors, encompassing a total of 4,414 market transactions.

The study employs basic data analysis tools to comprehend market dynamic and structure. We utilized various statistical analyses, such as descriptive statistics, growth rate analysis, and diversity index calculations.

Market Structure Analysis: HHI

The Herfindahl-Hirschman Index (HHI) is a tool used to measure market concentration, which can specify market structure, and competitive behaviors. HHI is employed in this analysis, taking into account the market share of all companies, with a particular emphasis on larger entities. The formula for calculating HHI is as follows:

$$HHI = \sum_{i=1}^n S_i^2$$

Where n is the total number of companies, and S_i is the market share of the cannabis farm (ordered from highest to lowest). Interpreting the HHI values, a score below 100 indicates a highly competitive market, between 100 and 1,500 suggests a deconcentrated market, 1,500 to 2,500 signifies a concentrated market, and values surpassing 2,500 indicate a highly concentrated market.

By applying these methodologies, we attain understanding of market competitiveness, concentration within Thailand's cannabis cultivation sector. This analysis helps us comprehend on the industry's structural and competitive dynamics, offering valuable insights for researchers, economic stakeholders, and policymakers alike.

Research Results

Context Thailand's Cannabis Cultivation Industry (2019-2021)

In the period spanning 2019-2021, the cannabis cultivation industry in Thailand witnessed registered entities within the cannabis cultivation industry authorized to sale various parts of the cannabis, excluding flowering tops due to their THC content exceeding 0.2% (Narcotics Act No.7, 2019). These flowering tops were mandated to be submitted to the Ministry of Public Health for medical purposes. Conversely, other plant parts, such as leaves, stems, and roots, can be sold to midstream and downstream manufacturers registered with The Narcotics Control Division, finding applications in medical, food, beverage, and cosmetic sectors. (Assanangkornchai et al., 2022)

During that period, eligible registrants for cannabis cultivation were limited to three distinct groups: public sector entities, educational institutions, and community enterprises registered as agricultural community enterprises (Bednarek et al., 2022) as shown in Table 1.

Table 1 Registered Firms and Cannabis Cultivation Area in Thailand (2019-2021)

Registered Type	unit	2019	2020	2021
Number of firm (Total)	Firms	10	65	342
Public sector		1	10	18
Educational institutions		7	22	31
Community enterprises		2	33	293
Area (Total)	square meters	10,944	42,993.09	87,632.62
Public sector		100	5,188.48	6,669.48
Educational institutions		7,784	24,311	22,944.91
Community enterprises		3,060	13,493.61	58,018.23

Source: Ministry of Public Health (2021).

Table 1 summarizes the number of registered entities in the cannabis industry surged from 10 firms in 2019 to 342 in 2021 (Thai Food and Drug Administration, 2022). Concurrently, cultivation space expanded from 10,944 square meters in 2019 to 87,632.62 square meters in 2021. Particularly noteworthy was the rapid growth of community enterprises, evident in both area and participants. Between 2019 and 2021, the number of entities increased by 146.5-fold, and cultivation area expanded by 18.96-fold. This surge was fueled by heightened awareness of legal changes permitting cannabis use in Thailand's food, beverage, and cosmetic sectors (Zinboonyahgoon et al., 2021). Registrations in the midstream and downstream industries rose, reaching 15, 45, and 153 from 2019 to 2021, indicating a 10.20-fold increase (Thai Food and Drug Administration, 2022).

Moreover, the analysis of 4,414 market transactions involving the trade of cannabis parts revealed that the majority were utilized in four main industries: food and beverage (5.30 tons, 70.39%), medical cannabis (1.43 tons, 18.99%), cosmetics (0.59 tons, 7.85%), and research and development (R&D) (0.21 tons, 2.78%). Notably, within the food and beverage industry, where cannabis parts with THC content below 0.2% were predominantly used, 1,149 market transactions (1.80 tons) involved the transformation of cannabis leaves into drinks, based on data from the Thai Food and Drug Administration (FDA).

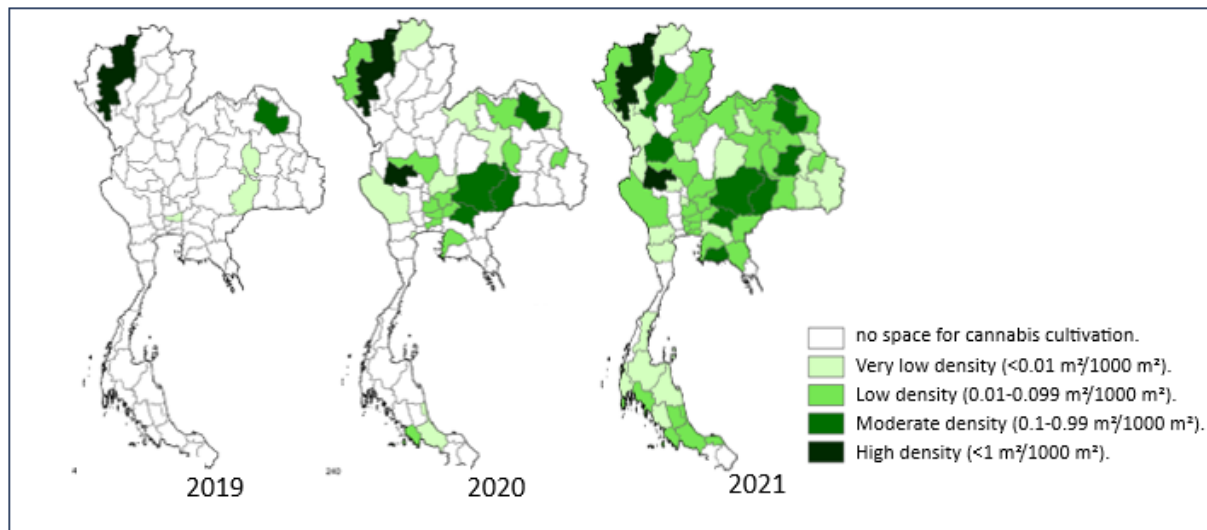


Figure 2 Distribution of Cannabis Cultivation Industry

In-depth analysis utilizing area distribution was conducted to evaluate spatial developments in cannabis cultivation. The analysis included the average registered cultivation area (square meter) and total aggregated production quantities for each year. The findings indicated a consistent increase and expansion of cultivation areas from 2019 to 2021. Most plantations were located in the northern and northeastern regions of Thailand, as illustrated in Figure 2. These transformations are likely to impact market structures and competitive behaviors. Additionally, an in-depth regional distribution analysis explored district-level specifics to assess the connection between midstream-downstream cannabis industry areas and registered cannabis farms from 2019 to 2021. Fisher's exact test was utilized to determine the statistical significance, spotlighting districts actively engaged in the cannabis industry.

Table 2 Relationship-cannabis industry, midstream-downstream, and cannabis farms

Year	Cannabis Industry Areas (N)	Midstream-Downstream Areas (Districts)	Cannabis Farm Areas (Districts)	p-value
2019	20	15	8	0.004
2020	79	39	56	0.000
2021	278	107	208	0.000

Table 2 reveals a statistically significant relationship ($p\text{-value} < 0.05$) between districts with a presence in the cannabis industry, specifically midstream and downstream areas, and districts with registered cannabis farms. This significant correlation from 2019 to 2021, suggesting that the presence of midstream and downstream cannabis industries in a district is correlated with the emergence and quantity of cannabis farms in the same area. This underscores how cannabis farms are integral to the supply chain, meeting the demand of midstream and downstream industries that process and distribute cannabis products.

Market Structure

Table 3 Results of the HHI for Thailand's Cannabis Cultivation Industry (2019-2021)

Year	HHI	Number of New Market Entry	Level of competition
2019	6,830.28	10	Highly Concentrated Market
2020	1,991.23	55	Concentrated Market
2021	956.19	277	Deconcentrated Market

Source: Thai Food and Drug Administration (2022).

The HHI analysis from Table 3 indicates changes in market concentration (Level of Competition) from 2019 to 2021, reflecting alterations in market concentration due to the entry of new market entries. The level of competition shows a trend toward deconcentrated market, aligning with the increased number of market entrants. Analyzing HHI values reveals a consistent decline, with an average HHI of 3,259.23. In 2021, the lowest HHI value of 956.19 corresponds to a shift to a deconcentrated market, in line with the influx of new firms, particularly community enterprises (260 registrations). However, legal constraints on cultivation permits contribute to community enterprises having lower registration numbers and production capacity compared to educational institutions (Narcotics Act No.7, 2019). The average production capacity of Community enterprises is 249 plants. Observing the dynamic impact of the new market entry, noting it influences market competition, and reflecting the evolving trends in Thailand's cannabis cultivation industry over the past three years with increased competition and market expansion and growth.

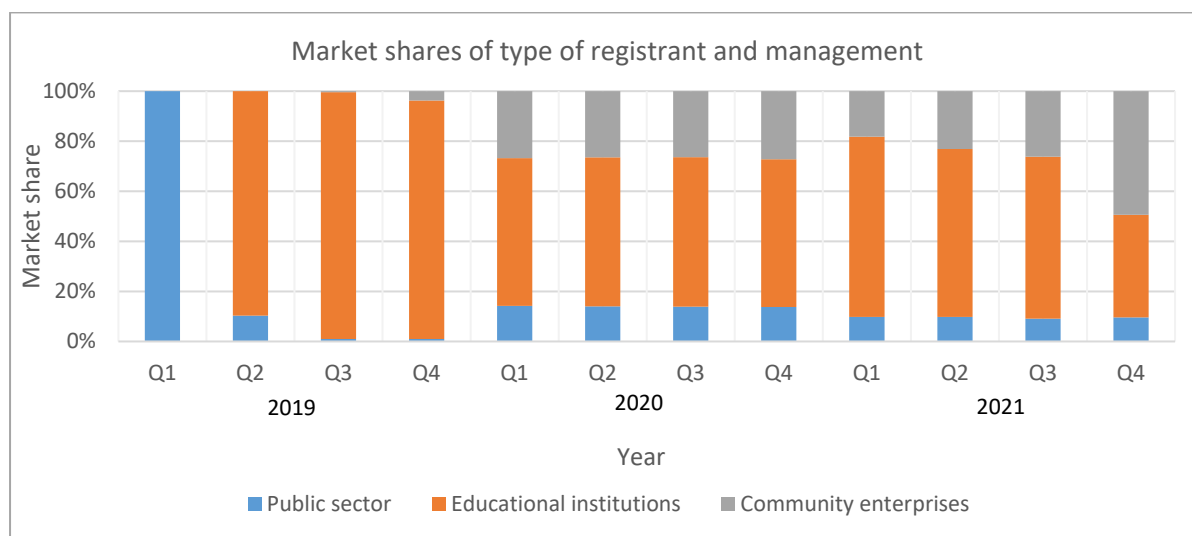


Figure 3 Market shares of type of registrant and management

Source: Thai Food and Drug Administration (2022).

In-depth analysis Market Share: Figure 3 presents the changing trends in market shares among the three types of cannabis farms - 1) Public sector, 2) Educational institutions, and 3) Community enterprises-from 2019 to 2021. Educational institutions consistently dominated the market shares of 95.24%, 59.03%, and 41.04% from 2019 to 2021. Public sector shares were 0.97%, 13.76%, and 9.59%, while community enterprises showed growth, reaching a peak of 49.36% in Q4 2021. This growth is attributed to the increase in new market entries, with 293 registrations in 2021. The figure illustrates the expanding and evolving market dynamics, especially in community enterprises, marked by substantial growth in Q1-Q4 2021, securing the highest market share of 49.36%. This growth is a result of the increased number of new market entries, showcasing the evolving landscape of Thailand's cannabis cultivation industry. The study demonstrates changes in market shares within Thailand's cannabis cultivation industry, particularly evident in the final quarter of the year. These transformations stem from regulatory changes in Thailand in 2021, allowing for the processing of cannabis components such as leaves and roots into cosmetic products. This legal amendment has driven increased demand for cannabis and subsequently led to higher numbers of new market entries among community enterprises.

Conclusion and Discussion

The findings of this study provide insights into the dynamics of market structure and competitive behavior within Thailand's cannabis cultivation industry, aligning with existing research across global contexts. The observed trends in Thailand's cannabis cultivation industry mirror those identified in studies from Spain and Washington. The surge in new market entries is consistent with research findings indicating that an increased number of firms positively impacts market competition (Alvarez et al., 2016; Bresnahan & Reiss, 1991). The shift in market concentration levels over the three-year period, transitioning from a highly concentrated market in 2019 to a deconcentrated market in 2021, is in line with previous studies that highlight the impact of market structure on competition (Giroldo & Hollenbeck, 2021). The market share analysis further supports the notion that educational institutions traditionally dominate the market, while community enterprises, with an influx of new registrations, are experiencing notable growth. This supports studies (Hammersvik et al., 2012) that have qualitatively studied the driving market expansion in the small-scale cannabis industry. These studies have analyzed the obstacles to the growth of community enterprise cultivators, revealing that production capacity affects the costs. This connection resonates with this study, indicating that community enterprises in Thailand's cannabis cultivation industry are cultivating in farms with lower production capacity compared to other producer groups.

Additionally, this study emphasizes a unique aspect: the correlation between districts hosting midstream-downstream cannabis industries and registered cannabis farms. This correlation offers fresh insights into spatial dynamics within the industry. The results reveal a significant link between market expansion and the spatial distribution of cannabis cultivation areas across districts involved in the cannabis industry, particularly in midstream and downstream areas. This finding aligns with Morrison et al. (2014), who shed light on the spatial dynamics of medical cannabis dispensaries in the United States. Their study underscores the relationship between cannabis demand, socioeconomic indicators, and dispensary presence, highlighting the importance of localized insights and demand dynamics in understanding the evolving cannabis industry landscape.

Directions Implications and Future

This study delves into Thailand's evolving cannabis cultivation industry, which has experienced significant regulatory and market transformations since 2019. Focusing on market concentration, competitive dynamics, and broader implications, the research utilizes the Herfindahl-Hirschman Index (HHI) to scrutinize trends from 2019 to 2021. The increase in new market entries, driven by transformative legislative changes, has significantly impacted the market structure and competition within the cannabis cultivation industry.

The findings of this study hold implications for various stakeholders, including policymakers, investors, and researchers. Policymakers can leverage these insights to refine regulatory frameworks that accommodate the growing number of participants, especially community enterprises. Understanding the market dynamics and trends will enable them to create regulations that ensure fair competition and sustainable growth within the industry.

For industry stakeholders, particularly those involved in cannabis cultivation, staying informed about market trends and dynamics is crucial. The rapid influx of new market entries and evolving market conditions necessitate that businesses adapt swiftly to remain competitive. This understanding can help them make strategic decisions and optimize their operations to better align with market changes.

Future research avenues could explore the enduring impacts of regulatory changes on market dynamics and competition. Additionally, a deeper analysis of the unique challenges faced by community enterprises, such as constraints related to cultivation permits, could provide valuable insights into fostering their sustainable growth.

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Data Availability Statement: The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Conflicts of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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