

Tapioca Pearl Futures Design Analysis

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Abstract. The rapid expansion of the bubble tea market has intensified the risks of price volatility in the supply chain, especially for the core ingredient, tapioca pearl. However, there are still an absence of standardized financial instruments in the market to hedge these risks due to some reasons. This paper discusses the necessity and feasibility of introducing tapioca pearl futures. It first examines the price risk transmission mechanisms within the bubble tea industry, and then analyzes the impacts of price volatility in the primary producing regions of tapioca starch, the key raw material. Furthermore, the research proposes standardized contract specifications tailored for pearl tapioca, encompassing but not limited to critical elements such as delivery grade standards, contract unit design, and delivery methods. This paper also points out some potential challenges of this futures contract. The analysis of tapioca pearl futures holds significant theoretical and practical value. It expands research on the niche commodities and helps bubble tea supply chain enterprises effectively manage price volatility risks of raw materials like tapioca starch, while improving supply chain financial instruments. It can also enhance international trade stability.

Keywords: Tapioca pearl, Futures, Bubble tea industry, Price risk hedging

1. Introduction

Tapioca pearls, made from tapioca starch and water, are an essential ingredient in bubble tea and have gained popularity worldwide for their unique taste [1]. With the explosive global expansion of the freshly made tea beverage industry, the demand for tapioca pearls continues to rise. From cassava plantations in Southeast Asia to bubble tea shops worldwide, the pearl supply chain has achieved large-scale development and continues to innovate. As tea brands expand globally, the international trade volume of pearls has grown significantly. During 2017-2023, the calculated CAGR of the bubble tea market achieved 7.3% [2]. Despite the impact of the COVID-19 pandemic and global economic conditions, the total number of Gong Cha stores has increased to nearly 1,800 stores across 22 countries in Q1 2022 [3]. Due to the enormous trading volume, price fluctuations are increasingly drawing attention: even a slight change in unit price may lead to significant fluctuations in the overall price, impacting multiple stakeholders across the supply chain. Hence, futures contracts are needed to hedge against the risks arising from price volatility. However, currently, tapioca pearl futures are not yet available in the market. One of the reasons may be that the market size remains relatively small compared to major commodities like oil or soybeans.

Additionally, price volatility is complex and difficult to forecast. This paper gives an example of tapioca pearl futures and some support for further research. This design can not only help to hedge the price fluctuations of the tapioca pearl to reduce risks of uncertainty, but also can provide investors with more opportunities and asset allocation options, which can enhance the diversity of the commodity market.

2. Necessity of tapioca pearl futures

2.1. Hedging against raw material price risk

2.1.1. Supply side

From the perspective of raw material sources, the production and export policies of major cassava-producing regions, such as Thailand and Vietnam, have a profound impact on the supply of tapioca pearls. Thailand's cassava exports were valued at USD 1.42 billion in 2023 and USD 1.59 billion in 2024, and they account for approximately 67% of global cassava exports [4]. The climate conditions in Thailand and Vietnam are complex and changeable, with frequent occurrences of extreme weather such as typhoons and heavy rains. These natural disasters are highly likely to lead to a reduction in cassava production. Once the production decreases, the prices will soar significantly and put suppliers in a difficult situation of sharply rising costs. In addition, for the purposes of safeguarding domestic industrial development and stabilizing the domestic market, the government may suddenly adjust policies such as export tariffs and quota restrictions. In such a situation, without effective price risk management measures, suppliers are likely to suffer huge economic losses due to the drastic fluctuations in raw material prices. However, tapioca pearl futures can provide suppliers with a hedging platform. By conducting reverse operations in the futures market, suppliers can lock in raw material purchase prices in advance, ensure cost stability and maintain the normal production and operation of their enterprises.

2.1.2. Demand side

In China and even worldwide, the bubble tea culture is extremely popular, and bubble tea shops are springing up on every street corner. From the bustling business districts of first-tier cities to the backstreets of third- and fourth-tier cities, the demand for tapioca pearls continues to soar. However, this rapid expansion also brings a great deal of uncertainty. Once market demand far exceeds expectations, the supply of tapioca pearls may fall short, causing prices to surge significantly. Unfavorable market shocks for food commodities can raise not only real food prices but also consumer prices, leading to a sustained decline in real GDP and consumer spending [5]. Take chain bubble tea brands as an example. If they fail to lock in the purchase price of tapioca pearls in advance, the sudden price increase will sharply raise raw material costs, squeeze profit margins, and may even force them to adjust product prices due to excessively high costs, which will lower their market competitiveness and reduce consumers' willingness to buy. Tapioca pearl futures, on the other hand, offer demand-side parties the possibility of stabilizing procurement costs. By conducting operations in the futures market, demand-side parties can lock in appropriate prices in advance, avoid the risk of price surges caused by market expansion, and ensure the stability of business operations and profitability.

2.2. Drive industry standardization

The launch of pearl tapioca futures can significantly drive industry standardization. The advantages of the futures market are price transparency and information on the price of expected products [6]. Firstly, the pricing mechanism of futures contracts relies on unified quality standards, which will compel upstream producers to standardize raw material selection, processing techniques, and product specifications, ensuring consistent quality of tapioca pearls. Secondly, the transparent pricing in the futures market reduces information asymmetry, encouraging companies to align with mainstream delivery standards and phase out non-compliant products that fail to meet market demand—this also enhances food safety. Additionally, standardized contracts establish a quantifiable quality evaluation system for the industry by defining key metrics such as particle size, elasticity, and ingredient composition, helping to resolve long-standing issues of market disorder caused by the lack of standards. Finally, the quality inspection system of futures delivery warehouses will serve as an industry benchmark, promoting standardized upgrades across the entire supply chain—from production and storage to sales—ultimately improving the coordination efficiency and global competitiveness of pearl tapioca in the beverage supply chain.

2.3. Facilitate global collaboration

The introduction of pearl tapioca futures can play a significant role in facilitating global industry collaboration. Firstly, standardized futures contracts provide a unified quality benchmark and pricing reference for cross-border trade, significantly reducing procurement risks for international buyers and enhancing the efficiency of global transactions. Second, the global reach of futures markets can synchronize supply-and-demand data from producing regions and consumer hubs, laying the groundwork for a universally accepted quality-certification scheme for tapioca pearls and dismantling trade barriers rooted in divergent national standards. Furthermore, through the global network of futures delivery warehouses, a transnational quality mutual recognition mechanism can be established, allowing premium tapioca pearls from major production regions like Southeast Asia to seamlessly enter the international beverage supply chain. Additionally, Thai cassava exporters are facing tough times as China switches from cassava chips to coal as a raw material for ethanol production [7]. Therefore, the implementation of tapioca pearl futures can also help stabilize its export volume and alleviate pressure.

3. Feasibility of tapioca pearl futures

3.1. Market participants

3.1.1. Raw material growers (farmers)

Tapioca pearl raw material growers can reference futures contract prices when negotiating long-term supply agreements with manufacturers to safeguard their profits. Firstly, cassava growers possess critical data on cultivation acreage, weather impacts, and inventory fluctuations, while facing inherent price volatility risks—tapioca starch prices may fluctuate dramatically during the 6-8 months growth cycle from planting to harvest. By participating in futures markets, growers can lock in selling prices in advance to effectively hedge against potential price declines. Moreover, as the futures market matures, standardized price signals will inversely guide planting decisions. When forward prices indicate rising tapioca demand, growers can rationally expand cassava cultivation, creating a virtuous cycle where “futures prices guide planting plans” to stabilize industry cycles.

Finally, large-scale grower cooperatives typically maintain long-term partnerships with tapioca processors. Their market participation will enhance overall liquidity and trading activity in futures contracts. This vertical integration across the supply chain creates a more robust and efficient hedging ecosystem for all industry participants.

3.1.2. Pearl manufacturers & suppliers

The involvement of pearl tapioca producers makes futures trading more reliable and practical. First, producers benefit from stabilizing raw material costs. Since tapioca pearls mainly consist of cassava starch, price fluctuations create uncertainty and risk for manufacturers. Futures markets allow them to lock in purchase prices in advance to protect their profits. Second, large manufacturers help establish quality standards for futures trading. They enforce strict specifications for tapioca pearls, including elasticity, size, and starch content—precisely the criteria needed for standardized futures contracts. After all, futures trading requires uniformity, meaning the product quality must be consistent across all transactions. Finally, producers enhance market liquidity. As industry experts, they understand market trends—knowing when bubble tea demand peaks or slows. Their trading activities make futures prices more accurate, reflecting real-time supply and demand dynamics. In short, producers do not just participate in futures markets for speculation—they rely on them for risk management. Their presence turns futures contracts from a theoretical concept into a practical tool that benefits the entire supply chain.

3.1.3. Bubble tea brands & chains

The participation of bubble tea brands significantly enhances the feasibility of tapioca pearl futures. First, bubble tea shops serve as direct purchasers in the tapioca pearl futures market. Major chains typically consume dozens of tons of tapioca pearls monthly, with this substantial and consistent demand forming the fundamental basis for the futures market. Besides, bubble tea operators possess unparalleled market insight. Their trading activities in the futures market effectively translate cyclical demand fluctuations into price signals, thereby enhancing pricing accuracy. Furthermore, futures contracts enable shops to lock in costs. This mechanism ensures operational stability regardless of subsequent raw material price increases, while also providing clear visibility on maximum potential losses should prices decline—substantially mitigating financial risks. Moreover, a growing number of bubble tea brands and chain stores have emerged; some universities even establish dedicated bubble tea stations on campuses. For example, a university in New York set up a bubble tea station operating during daytime hours, allowing students to customize their preferred flavors. Since its establishment, the station has increased 11.8% in incremental sales [8]. This can significantly enhance both the market liquidity of tapioca pearls and the feasibility of tapioca pearl futures.

3.1.4. Consumers

While consumers do not directly participate in futures trading, their purchasing behaviors profoundly influence the operation of the tapioca pearl futures market. First, consumer preferences determine market demand. In the era of technological advancements, the prevalence of online customer reviews has led to an expanded repository of information related to product quality, influencing consumer choices in terms of dietary choices [9]. When a particular bubble tea product goes viral on social media and triggers a buying frenzy, tea shops must urgently increase their

tapioca pearl purchases. Sudden demand surges or slumps are instantly mirrored in futures prices, flashing clear signals to traders. Likewise, if consumers pivot to pearl-free drinks, the resulting drop in tapioca demand will register immediately in the futures market. Second, seasonal consumption patterns create predictable market cycles. Summer tea sales are typically higher than in winter. This stable, recurring trend allows futures traders to plan ahead. Most importantly, consumer quality demands drive standardization. Younger consumers today pay close attention to details like tapioca pearls' chewiness and flavor profiles, pushing tea brands to establish strict ingredient standards. These standards, in turn, become the quality benchmarks for futures contracts. In summary, consumers indirectly enhance the viability of tapioca pearl futures by shaping real-world demand cycles and quality expectations—key factors that make futures contracts practical for risk management.

3.2. Standardization of tapioca pearl

The standardization of tapioca pearls serves as a fundamental pillar for the smooth operation of futures markets. Primarily, unified quality specifications, such as diameter and elasticity test results, create clear, objective benchmarks for futures contracts. These quantifiable parameters ensure all market participants share identical expectations regarding the traded commodity, eliminating subjective interpretation. Secondly, standardization significantly reduces transaction costs. Quality inspectors can swiftly verify compliance with established standards using standardized testing equipment, bypassing the need for complex laboratory analysis for each batch. This pass/fail evaluation system streamlines the delivery process. Moreover, standardization enhances market confidence. When participants know futures contracts represent consistently certified-compliant commodities rather than approximate equivalents, more traders are willing to engage. Consequently, the easy standardization characteristics of tapioca pearls substantially improve the feasibility of their futures contracts.

4. Tapioca pearl futures design

4.1. Contract specifications

This paper designs a detailed futures contract for tapioca pearl, with Table 1 presenting the specifications of the contract. The tapioca pearl futures contract is standardized at 10 tons per contract for 6000 yuan per ton, which is equivalent to approximately 20000 cups of bubble tea, aligning with conventional procurement practices. It uses physical delivery and the deliveries locate in bubble tea industry hubs. The delivery months are March, June, September, and December. The last trading day is the 10th business day of the contract month and the final settlement day is the 3rd business day after the last trading day.

Table 1. Contract specifications for tapioca pearl futures

Categories	Description
Futures Name	Tapioca Pearl Futures
Contract Size & Price	10 ton; 6,000 CNY/ton
Delivery Method	Physical delivery
Delivery Locations	Bubble tea industry hubs
Contract Month	March, June, September, December
Last Trading Day	The 10th business day of the contract month
Final Settlement Day	The 3rd business day after the last trading day

4.2. Delivery specifications

This paper also gives some specifications of delivery rules. Table 2 specifies the standards for tapioca pearls, including their size, elasticity, content, and hygiene requirements. Since buyers can choose between purchasing dried pearls or pre-cooked pearls, the table provides the respective packaging methods for both types. Additionally, it outlines certification requirements and provisions for substitutes.

Table 2. Delivery specifications for tapioca pearl futures

Categories	Standards
Size	Diameter 5mm±0.5mm
Elasticity	Elasticity-test result ≥ 0.8
Content	Tapioca starch content $\geq 85\%$, moisture $\leq 12\%$
Hygiene Standard	Compliant with FDA/GB standards (Total bacterial count ≤ 1000 CFU/g, preservative-free)
Packaging	Dried Pearls: 25kg/bag, double-layer moisture-proof packaging, labeled with production date and batch number. Pre-cooked Pearls: Vacuum-packed (10kg/box), shelf life ≥ 6 months, requires cold chain transportation.
Certification	Only accept suppliers certified by the exchange (e.g., leading manufacturers from Taiwan, Thailand).
Substitutes	Brown Sugar Pearls: Requires a 3% premium (must be declared in advance); Colored Pearls: Subject to a 2% discount (safety certification for coloring agents must be provided).

5. Potential challenges

5.1. Cold chain costs

If buyers choose to purchase dry tapioca pearls, this issue is avoided. However, if they want pre-cooked pearls, the entire cold chain storage and transportation process becomes necessary, which presents significant challenges. First, delivery warehouses must be equipped with specialized refrigeration facilities, with construction and operational costs much higher than standard warehouses. However, refrigerated storage can be improved by optimizing technologies such as chillers [10]. Moreover, transportation requires refrigerated trucks, increasing freight costs compared

to regular trucks. If temperature control fails during transit, causing spoilage, it can lead to delivery disputes. Ultimately, these additional costs will either be passed on to traders or lead to the participation reduction of people in the tapioca pearl futures market.

5.2. Cross-border delivery compliance

Cross-border delivery compliance presents another practical challenge for tapioca pearl futures. Significant differences in food regulatory standards across countries make international delivery of tapioca pearls particularly difficult. Each country has distinct requirements for food additives and hygiene standards. Complex customs formalities require exhaustive inspection and quarantine documentation; even a minor error can detain or reject an entire shipment. More problematic are political factors, such as sudden tariff increases or temporary trade bans, which introduce further uncertainty. These compliance issues create ripple effects: they either drive up delivery costs, distorting futures prices, or prevent buyers from certain countries from participating at all, limiting market liquidity. Addressing this challenge may require establishing an internationally recognized quality certification system for tapioca pearls—though achieving this would demand long-term coordination among global regulatory agencies.

6. Conclusion

This paper innovatively proposes a brand-new futures product concept—Tapioca Pearl Futures. It begins with an in-depth analysis of the global bubble tea market, pointing out the explosive growth trend the industry has shown in recent years. As the core ingredient of bubble tea, tapioca pearls have seen continuously rising annual demand along with price fluctuations that may bring significant operational risks to upstream and downstream enterprises, necessitating risk hedging through futures instruments. In the necessity demonstration section, this paper explains and analyzes from three aspects: price risk hedging, promoting industrial standardization, and facilitating global industry collaboration. For the feasibility analysis, this paper introduces four major market participants and the easy-to-standardize advantages of tapioca pearls. Furthermore, it innovatively designs a complete set of tapioca pearl futures contract solutions, including both contract specifications and delivery protocols. Despite the promising prospects, the paper objectively points out two major challenges facing tapioca pearl futures: at the technical level, the relatively high cold chain storage and transportation costs for pre-cooked pearls may become an obstacle; at the institutional level, differences in food safety standards among countries and other factors may create compliance barriers for cross-border delivery. To address these issues, the paper suggests that industry leaders should take the initiative to jointly promote solutions with financial institutions. In conclusion, tapioca pearl futures possess significant market feasibility and practical necessity. Their successful implementation requires leading industry brands to set an example through actual participation to drive market liquidity. This innovative financial instrument will not only effectively manage price risks but also promote the development of the entire tea beverage industry chain towards greater standardization and normalization, possessing important practical value and exemplary significance.

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