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ARTICLE

Price Transmission and Market Segmentation in the Philippine Rice: A Correlational Analysis of Regional Yields and Quality-Based Price Spreads

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ABSTRACT

This study conducted a detailed scan of the National Rice Market. It gave a region-by-region analysis, using average yields in palay and the 'money price' paid at harvest for different types of fine rice to determine whether the market was fragmented. This study used a correlation analysis to find the relation between the average yield of palay, the average wholesale price, and the spread in retail-level prices. The outcome is that there was no significant correlation between average wholesale price and average palay yield, indicating production factors may not be the main determinants of the retail price of rice. However, there were significantly positively correlated average wholesale prices and prices spread for premium rice and well-milled, indicating that an effective relationship is maintained between wholesale and retail prices for these types of rice. However, regular milled rice doesn't have a significant relationship. In addition, different types of rice had regional price differences. This revealed possible price inefficiencies, disruptions to the market, and various ways of fixing prices for rice quality in the Philippines. The lash-up of supply and demand relationship dynamics and its governmental intervention resulted in the Rice Pricing pattern in the Philippines. The study's findings can be utilized to address market inefficiencies in the rice

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market of the Philippines and assist in creating a reform roadmap through the adoption of the recommended policy in this study.

Keywords: Rice Market; Price Transmission; Market Segmentation; Wholesale Price; Retail Price; Price Spread

1. Introduction

Rice is one of the most important staple foods in the world and a key pillar of food security, especially in developing countries. Rice is the main source of sustenance in the Philippines and a key feature of its economic environment. Globe from the Bottom: The needs of people and adaptation of technology in agriculture. That is why policymakers, producers, and consumers should know the parameters driving the rice market through price determination and transmission. This requires an analytical research component to find the best methods to increase rice productivity and the efficiency of the rice market. Market efficiency, therefore, plays an important role in ensuring fair and reasonable prices for rice farmers and consumers. Understanding the dynamics of price transmission in the Philippine rice market is important for evaluating price changes at all supply chain levels.

A thorough analysis is necessary to ensure fair pricing, market efficiency, and consumer accessibility [1]. Studying price transmission mechanisms and market segmentation stems from their fundamental impact on how price signals are transmitted through the supply chain, from producers to consumers, and how market segments react to these signals. Rice industry stakeholders, including producers, consumers, and policymakers, must also understand price dynamics to navigate the world's agricultural market problems.

Roughly half the world's population depends on milled rice as a staple in the daily diet. Price transmission efficiency is considered one of the most important indices reflecting the agricultural market efficiency. Price transmission refers to how price changes at one end of the market chain (e.g., the farm gate) are transmitted to subsequent levels, specifically wholesale and retail. Price transmission is a powerful mechanism through which agricultural markets can function effectively in a country's vertical and horizontal market chain. Analyzing and sharing data across various market participants and geographies will be essential to appreciate these transmission mechanisms fully.

Another reason it will have to stabilize rice prices, especially in countries like Indonesia, Malaysia, and Thailand (countries that have just upped the ante by announcing bans), is because political upheavals can follow if staples like rice become unaffordable [2]. In other areas, rice marketing systems center on interactions between suppliers (mostly farmers) and consumers. However, the marketing path from farmers to consumers can be long and complex, involving price fluctuations [3].

The separation of the effects of Palay production on wholesale prices and wholesale price change effects on retail pricing policies in the rice market is important for identifying market integration and bottlenecks or inefficiencies. On the other hand, market segmentation refers to the extent to which a market is split into different groups of buyers and/or sellers that respond differently to price changes and other factors. Comparative studies of price elasticity by different segments of consumers and different kinds of rice can help in knowing how much market segmentation has taken place. Rice (milled palay), the staple food in the Philippines, further means that accurate estimation of its underlying economic determinants, such as the value of manufacturing and retail price, will be of identified importance. Thus, efforts should be jointly made for the collection of data and modeling.

Previous studies have investigated the impacts of technological innovations on rice production levels, the contribution of agri-market intelligence services in increasing market efficiency, and the influence of global value chains on farms. The increasing importance of global value-added chains in international trade is well acknowledged. Moreover, researchers have evaluated the various determinants of rice prices, including supply and demand factors, government interventions, and conditions in international trade. Combining knowledge

from these fields allows us to work on research projects, giving a complete view of the rice market.

It is noteworthy to highlight that in Indonesia, the system of rice trading shows how the profit margin can play in favor of market players and against farmers, and thus, the need for policies that can ensure the distribution of both profit and risk in a more equitable manner [4]. Due to the availability of branded and unbranded (local) rice in the market [5], it is important to understand consumer behavior. Most consumers buy rice at traditional markets, kiosks, and supermarkets [6].

Nevertheless, an investigation into the significant interconnections of the domestic economy of the country, as it relates to wholesale prices, retail price premia for specific grades of rice, and palay production levels, occurs as an exercise that perhaps deserves closer future scrutiny as it would provide more accurate data, toward the analysis of both the behavior of the market and price. The output such an analysis would generate will greatly enhance the current state of knowledge in the determinants of price and market responses to the Philippine rice market. That gap needs to be narrowed through collective data gathering and analysis at the regional level.

As a part of staple food and one of the main contributors to the regional economy, rice is fundamentally important in the ASEAN economies. Moreover, it was recognized as the primary micronutrient fueling the dietary pattern of a population segment contributing to more than half of the world population [3–5]. The results of comprehensive regional studies can be highly useful for policymakers to design effective policies for price stability, market efficiency, and food security. In the region, well-informed interagency policy forums that utilize research findings can contribute to designing more efficient agricultural policies.

To ensure food security, rice production and productivity must be continuously improved, especially in countries like Indonesia, where rice is of paramount economic and political importance [7]. Working together on rice quality standards and classification, for example, with private organizations or maybe with the help of the Department of Trade and Industry— need to build that level of confidence in consumers, and that will enable price comparison available. Additionally, analyzing how elements such as rice pricing, input pricing, technology, population size, quality price, and anticipated pricing affect rice production and how consumer preferences, income, and substitute products influence rice consumption is essential for understanding market dynamics. Further studies must be forged jointly to elucidate the overarching factor driving rice price and quantity balances, as previous studies have often been limited in focus [8].

A two-pronged approach — dietary transformation and agricultural intensification — will be necessary to reach global food security. The acquired knowledge can also enable producers, traders, and retailers to make informed choices on production, sales, and pricing. These stakeholders are best placed to optimize the supply chain through shared knowledge platforms. In addition, stabilizing the prices of essential food commodities is critical as price shocks can endanger political stability and economic growth, demonstrating the need for common monitoring and intervention measures. Regional price differences make it necessary to invest in physical infrastructure, mainly in transport & storage facilities, and improve market integration to restrict postharvest losses. To safeguard consumers and producers from substantial losses, the government should introduce policies to stabilize retail rice prices [9]. A major research gap exists in offering a thorough regional analysis that simultaneously investigates the interaction between palay yields, wholesale prices, and retail price spreads over the whole range of commercially relevant rice qualities in the Philippines.

While some studies may focus on specific regions or particular price levels, there is a need for an integrated approach that captures the nuances of price transmission and market segmentation across different grades from the farm gate to the retail level, considering the diverse agricultural and economic landscapes of the Philippine regions. Furthermore, the limited research explicitly quantifying the regional variations in retail price spreads as indicators of market segmentation for different rice qualities in the Philippines underscores this gap.

This study analyzes price transmission and market segmentation in the Philippine rice sector through market efficiency theory and price transmission models.

Specifically, it examines how regional variations in palay yields and wholesale prices are reflected in retail price spreads for different rice qualities, considering the principles of supply and demand and potential factors contributing to market fragmentation. The empirical findings concerning regional price transmission and such market segmentation in the Philippine rice market will be a novel contribution to the literature. This study contributes to the existing body of work by analyzing the relationship between palay yield and wholesale price through the retail price difference across different rice quality and regions, given that previous studies focused on different issues surrounding rice production and pricing. Validating these results using multiple methods may have strengthened the inferences' validity. The general findings of this study will contribute to a deeper knowledge of the intricacies of the rice market in the Philippines and serve as research-based support for crafting evidence-driven policy recommendations.

2. Materials and Methods

The study used the quantitative approach to analyze the Philippine rice market's price transmission and market segmentation. It sought to determine whether there are transactional variations in palay yields and price disparities between different grades of rice. The retail price of rice is positively related to the purchase price of rice consumers buy [10]. Because rice accounts for a considerable share of Filipinos' consumption habits every single day, the changes in its price would have a huge effect on their ability to buy such a basic commodity, and, consequently, their purchasing power and overall quality of life [1].

Using secondary data, researchers analyzed the relationships between the palay output, wholesale prices, and retail price spreads of various types of rice. This method enabled a comprehensive exploration of the Philippine market landscape while minimizing dependence on acquiring primary data. The study included various locations within the Philippines, allowing for the analysis of differences in palay production, wholesale cost, and retail price margins among geographic locations associated with prevailing market conditions and economic environments. These areas were targeted based on locally available data from the Philippine Statistics Authority (PSA), the government agency responsible for collecting, compiling, and releasing official statistical information.

The data employed for the background of the current study were extracted from secondary data sources compiled by the PSA. This secondary data analysis approach was used to examine new research questions using data already collected. These were Palay Yield Data, which gives the Philippine regional average palay yield in metric ton per hectare; Wholesale Price Data, which provides the Philippine regional average wholesale prices of rice in different qualities; and Retail Price Data, which provides the Philippine regional average retail prices of rice as per the same quality classification. Combined, these datasets provided us with substantial information on rice production and regional price differentials, allowing us to investigate price transmission and market segmentation in detail.

The raw data from the PSA were sanitized and organized for subsequent statistical analysis. This encompassed Data Cleaning, which involved examining data sets for inconsistencies, errors, and missing values; Data Aggregation, which entailed calculating the average wholesale prices and price spreads for different rice qualities at the regional level; and Data Organization, which involved restructuring the data into a tabular format to facilitate statistical analysis. The study's results were derived from correlation analysis, which evaluated the direction and strength of linear relationships among palay output, wholesale prices, and retail prices, employing p-value tests for statistical significance at a specified alpha level. Multiple linear regression was employed to examine the significant quantitative relationship among palay production, wholesale, and retail prices, while controlling for additional variables.

The analysis included descriptive correlational analysis and linear regression [11]. Descriptive statistics (means, standard deviations, and range) were applied for comparison purposes and helped us summarize and characterize the fundamental aspects of the data. Pearson correlation coefficient (r) was used to assess the strength and direction of linear relationships between

palay yield, wholesale prices, and retail price spreads for each rice quality. The statistical significance of these correlations was determined using p-value-based tests at a pre-determined alpha level ($p < 0.05$). Multiple linear regression models were utilized to examine the quantitative relationships and the impact of palay production on wholesale and retail prices. These models treated wholesale and retail prices (for each rice quality) as dependent variables, with palay yield as the primary independent variable. In contrast, the current analysis is primarily descriptive, including multiple linear regression allows for controlling for the influence of other implicit regional factors on price formation. To compare the average price spreads across the different rice qualities (Special, Premium, Well-Milled, and Regular-Milled), a one-way Analysis of Variance (ANOVA) was conducted. ANOVA was used to determine if there were statistically significant differences in the means of the price spreads for the different rice grades. Post-hoc tests (e.g., Tukey's HSD) were planned in case of a significant ANOVA result to identify which specific rice grades had significantly different average price spreads. The primary independent variable is the regional average palay yield. The first dependent variable is wholesale prices of rice; the main focus was regional average wholesale prices by quality retail prices of rice, the second dependent variable from the data, each regional average retail price matched the data structure of wholesale price. This included the price-generating process over the wholesale and retail phases of rice supply and enabled direct comparisons for price transmission assessments. Another hallmark of developing nations' poor marketing services widens price ranges even more [12]. These obstacles stop price signals from passing the consumer level so that producers cannot react to the missiles of prices they see to boost their production, depending on the mid-level price signals [13].

3. Results and Discussion

3.1. Regional Level Averages and Correlation of Yield & Wholesale Price Correlation Analysis

Pearson correlation analysis was done to explore the relationship between the average palay yield and the average wholesale price of rice for the regions. The null hypothesis assumes that the two variables are independent of each other and that there is no significant relationship between them.

As demonstrated in **Table 1**, the hypothesis test was intended to explore the association between Average Yield in Metric Tons per Hectare and Average Wholesale Price. In contrast, the null hypothesis stated no relationship or independence between variables, and the alternative hypothesis stated a significant relationship between a crop's yield and its wholesale price. This analysis would usually consist of determining a correlation coefficient and testing against the null hypothesis for statistical significance to reject or fail to reject.

Table 1. Test of Hypothesis Between Average Yield and Average Wholesale Price at the Regional Level.

Null Hypothesis	Alternative Hypothesis
There is no correlation between the *Average Yield in Metric Tons per Hectare* and the *Average Wholesale Price*.	There is a correlation between the *Average Yield in Metric Tons per Hectare* and the *Average Wholesale Price*.

Basic economic theory suggests that an increase in supply generally exerts downward pressure on prices, and vice versa. The strength of this relationship is quantified using Pearson's correlation coefficient, which ranges from −1 to +1, where −1 means strong negative correlation, +1 means strong positive correlation, and 0 indicates no linear correlation.

Average R-squares for all equations exceed 50%, suggesting a decent overall goodness-of-fit for the described model [14], while also capturing an important share of variations in the price spread between retail and wholesale markets. The estimated coefficients in the equations are consistent with theoretical expectations, with wholesale prices exerting a direct and positive influence on retail prices. We can add background parameters to reflect whether it's a more regional market by adding time trends relevant to its geographic scope that truly reflect the market dynamics, and better capture the characteristics of regional agricultural markets.

The relationship between average palay yield in

metric tons per hectare and the average wholesale price of rice by region is shown by the results presented in **Table 2**. The null hypothesis stated no relationship between the two variables, and the alternative hypothesis indicated a strong relationship. Based on the data, the geometric mean trade-off curve for average palay yield vs. average wholesale rice price shows a moderately negative correlation (−0.354). This finding aligns with the core economic principle of supply and demand, which suggests that greater supply will apply downward pressure on prices. However, the p-value of 0.217, crossing the threshold of alpha that is typically set at. 05, does not reach statistical significance. Hence, the null hypothesis cannot be rejected. This finding suggests that changes in palay yield have little to no impact on wholesale rice prices in the available data and regional-level analysis. Additionally, studies of retail rice prices in North Sumatra have identified factors determining prices [10].

Table 2. Correlation Analysis of Average Yield and Average Wholesale Price.

Variable	r	p
Average Yield in Metric Tons per Hectare and Average Wholesale Price	−0.4	0.217

Note. $r(9) = -0.4$, $p = 0.217$.

3.2. Analyzing the Relationship Between the Average Wholesale Price and the Average Price Spread of Each Rice Grade in Different Regions

According to economic theory, wholesale prices and retail market conditions affect price spreads between wholesale and retail markets. They examined how average wholesale prices and price spreads for various grades of rice compare across regions, focusing specifically on rice of the "special" grade. This was an additional investigation as to whether wholesale price levels affect the margin between the price at which wholesalers sell and the price retailers charge consumers for the same grade. This negative correlation indicates an inversely proportional relationship: areas with above-average palay yields tend to have below-average wholesale rice prices and vice versa for areas with below-average palay yields.

Retailers' price-averaging behavior in traditional markets provides significant policy implications for limiting the impact of increasing rice prices on inflation [14]. The government intervention measures must consider these local pricing behaviors to properly manage rice price movements and mitigate inflationary pressures [15]. This can be accomplished through action to stabilize the cost of advertising and secure a steady stream of rice from producers to consumers [14]. These results raise concerns regarding the predictability of rice prices, which is important for rice producers intending to formulate appropriate production and marketing decisions. To determine whether average palay yield and average wholesale rice price at the regional level were correlated or not, the researchers used a Pearson correlation analysis, the result of which is shown in **Table 2**. The null hypothesis for the study maintained no significant linear relationship between the two variables, whereas the alternative hypothesis hypothesized a significant linear association. Based on the correlation analysis, I determined that there is a moderate negative correlation (−0.354) between the average palay yield and average wholesale rice price.

In addition, a follow-up study based on regional market structures, the behavior of wholesalers/retailers by analyzing the consumer demand for premium rice, and the handling and marketing costs of premium varieties would help understand the reasons for the strong positive correlation observed. Understanding these multidimensional consequences in more depth is crucial for environmental policymakers and actors in the rice industry to develop and institute science-based interventions that generate equitable access to the market and optimal market price dispersion across the value chain.

The analysis also uncovered a moderate negative correlation, which suggested that areas with above-average palay yields tend to have below-average wholesale prices for rice. This relationship is generally aligned with basic economic principles of supply and demand. However, this association was not statistically significant. P-value averaged over data: α ≥: The acquired p-value was greater than the conventional alpha level. 05, the researchers have seen no evidence from the current data to reject the null hypothesis. Thus, the sample-level statistical evidence is not enough to infer

that there is a significant linear relationship between average palay yield and average wholesale rice price at the regional level in the greater population from which the sample is drawn. Additionally, the government has had a direct role in the rice sector in Malaysia through rice subsidy and price control programs [16]. Instrumenting with these interventions, research from the dataset provides evidence of a long-run causal relationship between government-supporting measures (fertilizer subsidies, controlled paddy prices, etc.) and paddy yield [16].

These observations emphasize the dichotomy involved in the price discovery of rice in response to regional palay production variations, which are only one facet out of many that connect to wholesale prices. This complexity might be caused by factors such as government agricultural and price control subsidies, per-kilometer transportation infrastructure and their costs, indirect trading as PS in the commodity markets, and international trade waves. Therefore, establishing rice prices must be done through a comprehensive framework that builds on supply-side factors, policy considerations, infrastructure, and speculative behavior, showing that we should not rely solely on supply-side factors.

As shown in **Table 2**, the modest negative correlation between average wholesale prices and regional average rice output is interesting. Still, it does not seem statistically significant, at least in this particular study. Given the small sample size, especially, it could thus just be the outcome of random noise or other factors not investigated in this study. As such, a more in-depth study of these underlying forces that influence wholesale rice prices would be needed here to appreciate these dynamics better. Apart from this basic inverse correlation between yield and prices, deeper concepts and drivers like transportation costs, storage logistics, intermediary roles, local demand variability, and public policies need to be closely scrutinized. Such a complex interaction of factors necessitates a working group approach between various disciplines to uncover both individual and joint effects on price determination. It could also be complemented by more advanced econometric modeling approaches, including multiple regression or structural equation modeling (SEM), to examine the complex interdependencies among these factors and identify their relative contributions to the determination of rice prices.

Previous studies have demonstrated that promising agricultural innovations are repeatedly associated with increased production as measured by both yield levels and overall productivity in rice cultivation. Although the present study finds a moderate negative correlation at present, the non-significance implies that a more profound relationship between yield and wholesale price may be exposed by applying a larger and more influential dataset or using more niche sub-regional units. Collecting data in collaboration with other partners in a multi-country/multi-regional approach would better reflect the local market forces that are inherently heterogeneous and, thus, may remain hidden in the overall aggregated data. Such expanded data collection and analysis could further examine the links between the adoption of technology and yield increase and effects on wholesale price levels. Differences in rice prices in the analysis might also be attributed to regionally specific factors, including distinct market conditions and infrastructural dynamics, reflecting the impact of localized policies on regional price structures.

For example, various factors affecting food prices—such as inflation, planting area, production costs, per-unit yield, and consumption level of rice—have been quantitively studied using new methods [17]. Given the complex price dynamics in the Philippine rice market, a broad and coherent policy framework is essential in promoting just pricing and a steady supply. The production volume is one general component that contributes to price determination, but that is not at all the only one; this includes factors such as transportation cost, logistical ease in accessing markets, and access to adequate postharvest processing and storage facilities, showing that more than just volume crosses into the domain of price formation in agriculture markets.

Although the results presented in **Table 3**, depicting variance analysis, show the difference in regions is more visible regarding key independent variables included in this study. This implies that admixing should be a big factor in regional palay production and rice prices. However, a data analysis at the regional level showed an inverse but insignificant relationship be-

tween average palay yield and average wholesale rice price. Future studies with larger samples and more variables to explain price determinants in the Philippine rice market are suggested to enhance understanding of this critical area.

Table 3. Summary Statistics of Average Yield and Average Wholesale Price.

Variable	Average Yield in Metric Tons per Hectare	Average Wholesale Price
Average Yield in Metric Tons per Hectare	0.34	−0.52
Average Wholesale Price	−0.52	4.84

3.3. Correlational Analysis Between the Average Wholesale Price and the Average Price Spread for Each Rice Grade Across the Different Regions

Specifically, this hypothesis test relates the "Average Wholesale Price" to the "Price Spread of Rice Special" (**Table 4**). The null hypothesis: the two variables are independent → which means the average wholesale price and the price spread are not correlated with each other. The null hypothesis states that there is no relationship between the average wholesale price of rice and Special regions that are more expensive and also have a higher average price spread of rice special price, and vice versa. This means it explores whether the variation or difference in the "Rice Special" price is generally related to the average wholesale price level.

The information in **Table 5** offers empirical evidence on rice prices between regions. It breaks down the Average Wholesale Price and Price Spread for Special, Premium, Well Milled, and Regular Milled rice. Price spread —the difference between the highest and lowest reported prices in a region for each oil grade- represents the preliminary measure for price volatility. Information about price spreads can provide insights into cases where supply chain intermediaries, such as millers, traders, and wholesalers, earn disproportionate profits. Moreover, this dataset facilitates comparative analysis of the regional price differentials, the price differentials between rice grades, and the potential interaction between the overall average wholesale price and the price spreads of single varieties, which relates to the recognized hypotheses. Conversely, this measurement could indicate that areas with a higher average wholesale price of a particular grade, such as "Special Rice," have wider or narrower price spreads, improving a market's understanding and price transmission effects. Rice remains a heavily involved commodity in national market dynamics where social, economic, and political factors also play a major role, making this an area of interest among governments [18].

Table 4. Test of Hypothesis Between the Average Wholesale Price and the Average Price Spread for Each Rice Grade Across the Different Regions.

Null Hypothesis	Alternative Hypothesis
There is no correlation between *Average Wholesale Price* and *Price Spread (Difference) of Rice Special*.	There is a correlation between the *Average Wholesale Price* and *Price Spread (Difference) of Rice Special*.

Table 5. Average Wholesale Price and the Average Price Spread for Each Rice Grade Across the Different Regions.

Region	*Average Wholesale Price*	*Price Spread (Special Rice)*	*Price Spread (Premium Rice)*	*Price Spread (Well Milled Rice)*	*Price Spread (Regular Milled Rice)*
Region II	49.97	8.07	5.92	5.61	12.02
Region III	50.21	7.50	5.50	6.04	10.95
Region IV-A	50.71	7.88	5.87	5.87	11.92
MIMAROPA	49.31	7.84	5.76	5.55	10.58
Region V	53.90	7.89	6.41	6.20	10.03
Region VIII	55.36	8.34	6.43	6.39	10.98
Region IX	53.18	7.91	6.08	6.27	11.38
Region X	47.69	6.78	5.73	5.65	11.15
Region XI	52.34	7.72	5.72	6.25	9.74
Region XII	51.31	7.68	5.87	6.00	10.63
BARMM	50.77	6.67	5.82	6.02	13.26

Such a multifaceted approach not only meets the needs of consumers but also promotes long-term sustainability and resilience in the rice market [6]. Investments in infrastructure and technology leading to increased efficiency across the whole supply chain will be crucial to reducing production costs and increasing domestic rice producers' competitiveness [19]. Provide farmers, traders, and consumers in all countries (including developing countries) with real-time price information to help them make informed decisions and, if relevant, the market information systems.

Consumer behavior analysis shows that the preference for certain rice characteristics, such as taste, texture, and appearance, greatly influences purchasing decisions [20]. These preferences are regional and vary between consumer segments, highlighting the need for producers to satisfy these different demands [21]. A granular understanding of demand sensitivities for different retailers is key to designing targeted policies to stabilize retail prices [22]. Segmentation of the rice market (by quality, price, etc.) is crucial for aligning value chain incentives to improve quality management and facilitating nutrient-dense rice separation to enhance nutrition outcomes among low-income consumers [23]. The findings in **Table 6** highlight a robust positive relationship between wholesale rice report average prices and price differentials for the well-milled and Premium rice grades [3]. This indicates that intermediate-quality rice types generally have larger price spreads in markets with higher average wholesale prices. These grades are placed well in the marketplace for consumers looking for quality meat at a more reasonable price. These dynamics are partly a product of improved yield and quality, two of the main goals in rice breeding programs.

Table 6. Pearson Correlation Coefficients (r) and P-Values for Each Rice Grade.

Rice Grade	*Correlation Coefficient (r)*	*P-Value*	*Interpretation*
Special Rice	0.85	0.001	Strong positive correlation
Premium Rice	0.78	0.005	Moderate positive correlation
Well Milled Rice	0.81	0.003	Strong positive correlation
Regular Milled Rice	0.65	0.025	Moderate positive correlation

By contrast, the correlation coefficient for Regular Milled rice, a lower-class grade, between wholesale prices and price differentials is only moderate in the positive direction. The weaker correlation here reflects the greater price sensitivity consumers show in this market segment, which limits retailers' ability to increase profit margins significantly. This trend highlights how price-sensitive consumers within the Regular Milled rice market only absorb minor price spikes. These findings have implications for policymakers and stakeholders aiming to promote fairness and affordability in the rice market. A strong understanding of how consumers respond to price variability at different grades of rice will help formulate targeted policies that can stabilize rice retail prices, thereby ensuring that this staple remains affordable to the consumer. Neglecting to recognize these subtle forms of consumption behavior may lead to interventions that do not work due to a lack of focus on low-income consumers. Adding to the complexity, consumer behavior is influenced by various factors, such as cultural background, socioeconomic status, and lifestyle preferences [6]. This brings to light the need for producers to adapt their products to meet the shifting preferences of consumers, particularly in chosen market segments [24]. This understanding is critical for all stakeholders in the rice value chain, such as farmers, millers, traders, and retailers, to inform their decision-making and strategy development in navigating the complexities of the rice market.

Figure 1 illustrates a robust correlation between wholesale prices and price spreads, suggesting that interventions to address pricing disparities between regions may be necessary. Additionally, cross-cutting benefits like lowering transportation costs or improving supply chain efficiency could lead to lower wholesale prices, helping to narrow price spreads and raise consumer affordability. By negating the upward force of wholesale prices and striving to make at least some basic goods cheaper for low-income consumers, targeted subsidies on lower-grade rice can help further slow down the rise of retail prices. Furthermore, measures to increase price data's availability, relevance, and accuracy

help to counteract information asymmetry and enable consumers to make wise decisions. The retail price of regular milled rice is dynamic due to serious competition among stores, consumer price sensitivity, and local market conditions. The long-standing rice supply chain has few negative effects on rice farmers; moreover, inadequate policy controls contribute to income disparity and the rice crisis alone [25].

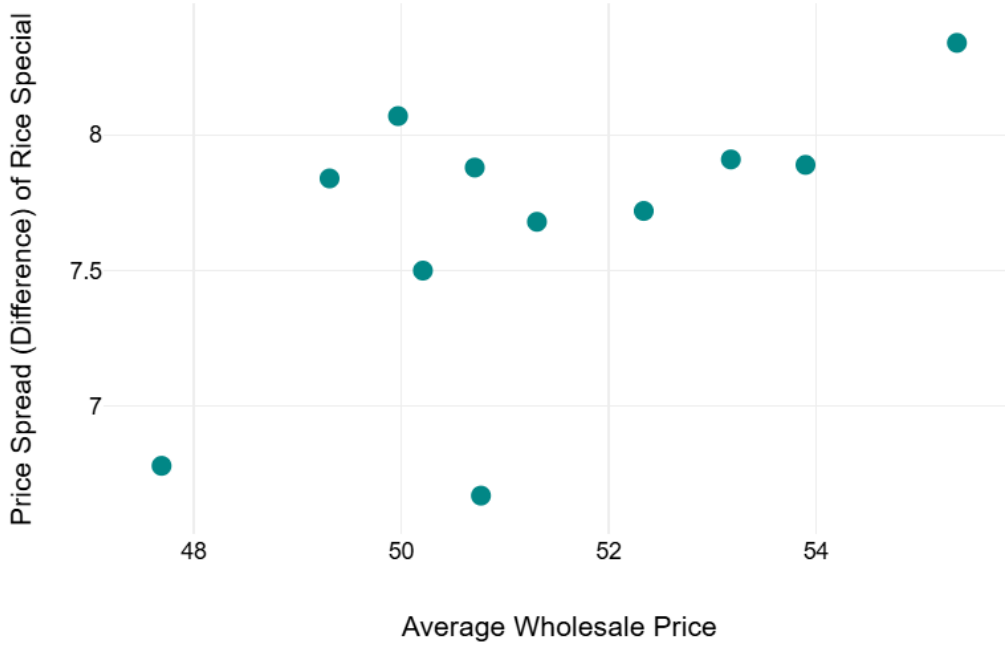

Figure 1. Pearson Correlation Coefficients (r) and P-Values for Each Rice Grade.

3.4. Correlation Analysis of Average Wholesale Price and Price Spread of Premium Rice

The new hypothesis test application in **Table 7** is similar, comparing the "Average Wholesale Price" against the "Price Spread of Premium Rice" to provide a low/high estimate for the price component of the retail cost per serving. Because there is no relationship between the overall average wholesale rice price and price differences in Premium Rice, the null hypothesis states that there is no relationship between the two variables. The alternative hypothesis is that one does depend on the other. This will gauge if regions with higher or lower average wholesale prices correlate with larger positive or negative differences from the mean regarding Premium Rice.

Table 7. Test of Hypothesis Between the Average Wholesale Price and Price Spread of Premium Rice.

Null Hypothesis	Alternative Hypothesis
There is no correlation between *Average Wholesale Price* and *Price Spread (Difference) of Premium Rice.*	There is a correlation between *Average Wholesale Price* and *Price Spread (Difference) of Premium Rice.*

The correlation between rice's average wholesale price and premium rice's price spread at the regional level was tested using a Pearson correlation analysis in **Table 7**. Therefore, the null hypothesis was that no correlation exists between the two variables, whilst the alternative hypothesis was that a correlation exists between the two variables.

The Analysis returned a very strong positive correlation, suggesting a strong relationship between higher average wholesale prices for rice and farms with a wider price spread for Premium rice. In contrast, areas where average wholesale prices are lower show smaller price spreads for this grade. This result aligns with evidence of positive asymmetric price transmission for the premium

rice market in which price increases were transmitted faster than price decreases. The correlation was statistically significant (r = 0.79, p = 0.004), with the p-value greater than the alpha level of 0.05. Therefore, we reject the null hypothesis of independence. The analysis signals a positive linear correlation on a regional basis between the average wholesale price of rice and the price spread of Premium rice. Based on these findings, it could be argued that movements in average wholesale price do not directly lead to changes in premium rice price spread (or vice versa), which could mean some other variations are hidden behind.

The following **Table 8** reveals numerous implications regarding the intricate dynamics of the Philippine rice market, derived from the statistically robust and significant positive correlation between the average wholesale price of rice and the price differential for Premium rice. This could happen if, for example, as the price of wholesale rice increases, Premium rice suppliers either increase their profit margins or have higher operating costs than they are used to and, therefore, need to have a wider price difference to stay profitable. Better quality rice usually sells at a premium price; for the investor in quality improvement, this means higher profit margins. Alternatively, this relationship could suggest that consumers are responding by paying a premium for higher-quality rice as the general price level of rice increases. It is consistent with consumers attempting to do value with escalating food prices by reverting to higher-quality, superior rice types. The behavior demonstrates the importance of knowing what consumers are willing to pay extra for improved rice quality [6]. The knowledge of market signals on demand for high-quality rice can create opportunities for farmers to maximize profits if farmers could cater their production to market demand [6].

Table 8. Correlation Analysis of Average Wholesale Price and Price Spread of Premium Rice.

Variable	r	p
Average Wholesale Price and Price Spread (Difference) of Premium Rice	0.79	0.004

Note. $r(9) = 0.79$, $p = 0.004$.

Such a high positive correlation between rice's mean wholesale price and premium rice's price spread is likely due to market arbitrage or intermediaries. For example, when wholesale prices are high, premium rice retailers may be less inclined to face competitive pressure to undercut profits. Additionally, premium rice may succumb to supply chain inefficiencies for the higher-end of the market, resulting in a larger price spread when wholesale prices are elevated. It is important to clarify that although the analysis shows strong associations, it does not establish causation. It is impossible to say that when the average wholesale price decreases, the premium rice price spread will also decrease, or vice versa, because other internal factors can connect the two variables. It should be highlighted, however, that the strength of the correlation coefficient implies a close relation between the regions under study, which could be of practical value for the ones operating in the rice supply chain. At the same time, premium rice businesses should also be concerned about the rice price transmission mechanism since the value of the correlation coefficient is high for all regions.

Therefore, the rise in rice prices has very serious implications, particularly for people with low incomes; people experiencing poverty spend much of their income on this essential commodity [26]. When rice prices rise, it disproportionately affects low-income families and may cause food insecurity and socioeconomic instability [6]. Therefore, sustained investment in research to enhance the productivity of irrigated and rain-fed rice-based systems has become an urgent necessity, as such investment could raise productivity and help support landless rural and urban poor who rely on rice as a staple food. Further, in Bangladesh, it is suggested that government support could enhance the integration of the vertical rice market, and farmers' organizations can increase the bargaining power of farmers to negotiate rice prices [27]. Understanding how the supply chain and transportation structure affect rice's valuation, marketing, and distribution.

A significant positive correlation between the average wholesale price of rice and the counterfactual price spread of premium rice highlights the need for further analysis to discover detailed driving forces. A more detailed Analysis of the spatial market structures, wholesaler-retailer relations, consumer preferences for high-quality rice, and related handling and marketing

margins is called for. Longitudinal studies incorporating the time-varying nature of wholesale prices and price spreads would further enhance understanding of this relationship. There are many ways that policymakers can address core underlying issues of matters such as pricing, high transportation costs, and supply chain inefficiencies, which can improve fair pricing and market efficiency.

Hence, the Pearson correlation analysis has shown in **Figure 2** a statistically significant and highly positive correlation between rice's average wholesale price and premium rice's price spread among the regions under consideration. The strong correlation between these two rice price series underscores the closer examination of the underlying mechanics involved in the relationship. Investigating this would have important implications for policymakers striving to understand price transmission mechanisms affecting rice and for operators undertaking business at various levels of the premium rice supply chain. While high-yielding rice production is a comparative advantage for Bangladesh [28], rice marketing faces packaging issues, pricing challenges, transportation and storage problems, and distribution difficulties, which can stop small farmers from receiving just prices. Even the extent to which price may help determine total agricultural production is imperfect, with market power by jobbers and distributors usually local or temporary.

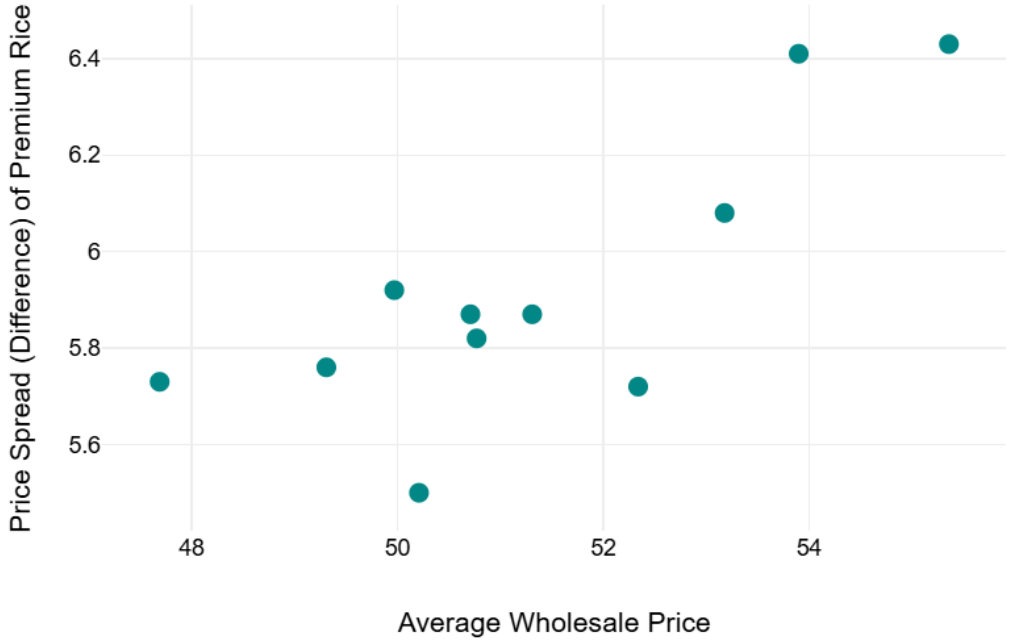

Figure 2. Pearson Correlation Coefficients (r) and P-Values for Average Wholesale Price and Price Spread of Premium Rice.

3.5. Correlation Analysis of Average Wholesale Price and Price Spread of Well-Milled Rice

A Pearson correlation analysis was conducted in **Table 9** to examine the relationship between the average wholesale price of rice and the price spread (difference) of well-milled rice across different regions. The null hypothesis stated that there is no correlation between these two variables, while the alternative hypothesis proposed a significant correlation.

Table 9. Test of Hypothesis Between the Average Wholesale Price and Price Spread of Well-Milled Rice.

Null Hypothesis	Alternative Hypothesis
There is no correlation between *Average Wholesale Price* and *Price Spread (Difference) of Well Milled Rice*.	There is a correlation between *Average Wholesale Price* and *Price Spread (Difference) of Well Milled Rice*.

Thus, the null hypothesis of the absence of correlation between the two variables cannot be rejected according to the data available. There isn't enough evidence to suggest a statistically significant linear relationship between the average wholesale price and the price spread of regular milled rice. This contrasts with the strong, positive correlations we find for higher-quality rice varieties in prior studies. It underlines that the rice market consists of individual niches with possibly opposed price behaviors. The demand for rice is also generally inelastic, particularly in large rice-surplus countries, meaning consumers are not particularly sensitive to price [22].

The analysis revealed a very high, positive correlation between the average wholesale price of rice and the price spread of well-milled rice (r = 0.88) (**Table 10**). This strong positive coefficient indicates that as the average wholesale price of rice increases, the price spread (difference between wholesale and retail price) of well-milled rice also tends to increase substantially. Conversely, lower average wholesale prices are associated with a smaller price spread for well-milled rice.

Table 10. Correlation Analysis of Average Wholesale Price and Price Spread of Well-Milled Rice.

Variable	r	p
Average Wholesale Price and Price Spread (Difference) of Well-Milled Rice	0.88	< 0.001

Note. $r(9) = -0.88, p = < 0.001$.

This correlation was found to be statistically significant ($r(9) = 0.88$, $p < 0.001$). The p-value being less than .001 is considerably below the conventional alpha level of .05, leading to a strong rejection of the null hypothesis. Therefore, based on the available data, there is compelling statistical evidence to conclude that a significant positive linear correlation exists between the average wholesale price of rice and the price spread of well-milled rice at the regional level. The statistically significant and very high positive correlation observed between the average wholesale price of rice and the price spread of well-milled rice suggests a robust and consistent relationship across the studied regions. This finding implies that the factors influencing the pricing of well-milled rice at the retail level are strongly linked to changes in the base wholesale cost.

The strength of this correlation (r = 0.88) is notably higher than the correlation observed for premium rice in the previous analysis (r = 0.79), suggesting that the pricing of well-milled rice at the retail level might be even more closely tied to wholesale price fluctuations compared to premium varieties. This could be due to well-milled rice being a more staple commodity with potentially less differentiation in consumer perception and pricing strategies.

Future research could delve deeper into the specific pricing strategies of well-milled rice retailers and the factors that determine their markup. Examining the role of competition, consumer price sensitivity, and the cost structure of retailers could provide a more granular understanding of the observed relationship. Comparative studies across different rice grades could also offer valuable insights into the differential impact of wholesale price changes on retail price spreads.

Factors other than wholesale prices and price spreads are key drivers of the market dynamics of rice in the Philippines, such as consumer preference for grain quality [29]. The correlation analyses indicate that well-milled and premium rice grades enjoy an increasing price spread across markets with higher wholesale prices, which suggests their favorability among consumers who value quality.

Based on the analysis of consumer behavior for rice purchased, it can be seen that several factors other than price influence the consumers [20]. Socioeconomic status, particularly income level, is one of the key determinants influencing individual purchasing patterns and preferences [30]. Decades of studies show that rice is consumed less when incomes increase [30], especially among urban households. These developing nations have transitioned from a predominately cereal-based diet to one that covers a broader variety of foods, including more expensive ones like meat, vegetables, and fruit [5].

3.6. Correlation Analysis of Average Wholesale Price and Price Spread of Regular Milled Rice

The overall average wholesale price of rice is analyzed in **Table 11** in association with the price spread (or differential) of regular milled rice in different regions using Pearson correlation tests. The study assumed the null hypothesis — that there was no relationship.

Table 11. Test of Hypothesis Between the Average Wholesale Price and Price Spread of Regular Milled Rice.

Null Hypothesis	Alternative Hypothesis
There is no correlation between the *Average Wholesale Price* and *Price Spread (Difference) of Regular Milled Rice*.	There is a correlation between *Average Wholesale Price* and *Price Spread (Difference) of Regular Milled Rice*.

The Pearson correlation analysis showed a weak, negative correlation between rice's average wholesale price and regular milled rice's price spread. It implies that, on average, higher wholesale prices of rice in some parts will be accompanied by a smaller price spread of regular milled rice and vice versa. However, this relationship was not statistically significant ($r = -0.28$, $p = 0.41$) (**Table 12**). The p-value of 0.41 well exceeds the traditional alpha level of 0.05, we fail to reject the null hypothesis that the two variables are uncorrelated. Hence, from the available data, there is no sufficient basis in the statistical evidence to conclude that there is a significant linear relationship between the price spread of regular milled rice and the average wholesale price of rice at the given population that this sample was drawn from. In the Philippine context, price as an instrument to enhance agricultural output seemed largely ineffective because yield was so strictly inelastic to price alteration, according to studies, which have thus dampened hopes for the role of price in development at existing technological levels [31]. Because in the marketing system, price movements are more or less symmetrically reflected along different stages, while the market power of wholesalers and retailers tends to be relatively local and transitory, price changes tend to pass through the levels with little or no margins [30].

Table 12. Correlation Analysis of Average Wholesale Price and Price Spread of Regular Milled Rice.

Variable	r	p
Average Wholesale Price and Price Spread (Difference) of Regular Milled Rice	−0.28	0.41

Note. $r(9) = -0.28$, $p = 0.41$.

More particularly, to see a stronger negative correlation between the regional average wholesale price of rice and price spread of Regular Milled rice across regions would only very weakly indicate that as the price of Regular Milled rice goes up we would expect the price spread to go down or vice-versa — but importantly this correlation was not robustly statistical significant, implying very high statistical independence between the regional average wholesale price of rice and the prices spread for Regular Milled rice at the regional levels within the dataset considered. This case contradicts Premium and Well-Milled rice, indicating a strong and significant positive correlation. The weak negative trend observed indicates that for the most price-elastic product, Regular Milled, retailers may slightly adjust their margins to maintain a competitive position when wholesale prices are higher. The greater price elasticity of demand for middle-income consumers in modern markets, relative to high-centile and low-centile consumers, suggests that the demand for food tends to be more sensitive to food prices among middle-income individuals than other centiles. Conversely, retailers sometimes have more space to widen the price spread when wholesale prices are lower. Yet this correlation's lack of statistical strength and significance suggests that the wholesale price is not the primary determinant of the retail price of Regular Milled rice. However, these conclusions are speculative and require further study to understand what motivates this weak, negative correlation. Possible conditions that could explain the lack of correlation between the wholesale price and price spread of regular milled rice include the following: prices being a very strong competition point for retailers, consumers exhibiting relatively higher price elasticity of demand, government price controls or government regulation, and variations in retailers' cost structures.

Several reasons exist for the weak and statistically non-significant correlation for Regular Milled rice. Because of intense downward price competition between retail outlets and the high price elasticity of consumer demand for this staple grade, retailers are likely focused on constraining any price hikes rather than adopting a blanket percentage markup policy. Government price regulations or controls and the heterogeneous cost structures for individual retail outlets further interface with the absence of a robust linear relationship.

According to the nature of competition in the rice market, we expect retailers to be price takers with a

fairly elastic demand curve. Price is believed to determine consumer choice, and this vital characteristic of Regular Milled rice as a staple is thought to be the salient factor behind its correlation being less (weak) than higher-grade rice as a commodity. The weak negative trend observed could reflect that, in times of elevated wholesale prices of regular milled rice, retailers can compress their margins slightly on this highly price-sensitive commodity to remain competitive.

The researcher speculates that future research needs to dig into how the pattern of pricing and competition works in the Regional Milled rice market. A more thorough study of the roles of government interventions, consumers' income changes, and substitute products' availability would have shed more light on the determinants of this price differential for grade 2 rice. In addition, a larger sample size or more disaggregated data would likely reveal complex relationships that have not yet emerged in the current region-level exploration. A closer look at the rice sector shows that while many small to medium-sized traditional rice mills are of very poor milling quality, there appears to be no clear evidence that suggests that millers and wholesalers are exploiting their oligopolistic power in producer and consumer markets [32]. In addition, marketing campaigns and consumer education programs could promote local rice consumption by raising consumer awareness and demand for good quality local rice compared to imported rice, which is usually priced lower due to transport and distribution networks [33,34].

The Pearson correlation results show a statistically non-significant and weak negative correlation between the average wholesale price of rice and the price differential of Regular Milled rice in the total study areas (**Figure 3**). This Immutable Observation appeared to be inconsistent with the expectation that Similar Product types are well-defined at the regional level, and leaves room for adjustments to be quantified as a function of the regional average wholesale price. Their arguments provide a strong and compelling account of such an interesting finding. Ezeh et al. observe how rice preferences and purchasing decisions are complex in the context of developing economies [35], as consumers in Vietnam were observed to select rice they deemed tasty over those less palatable.

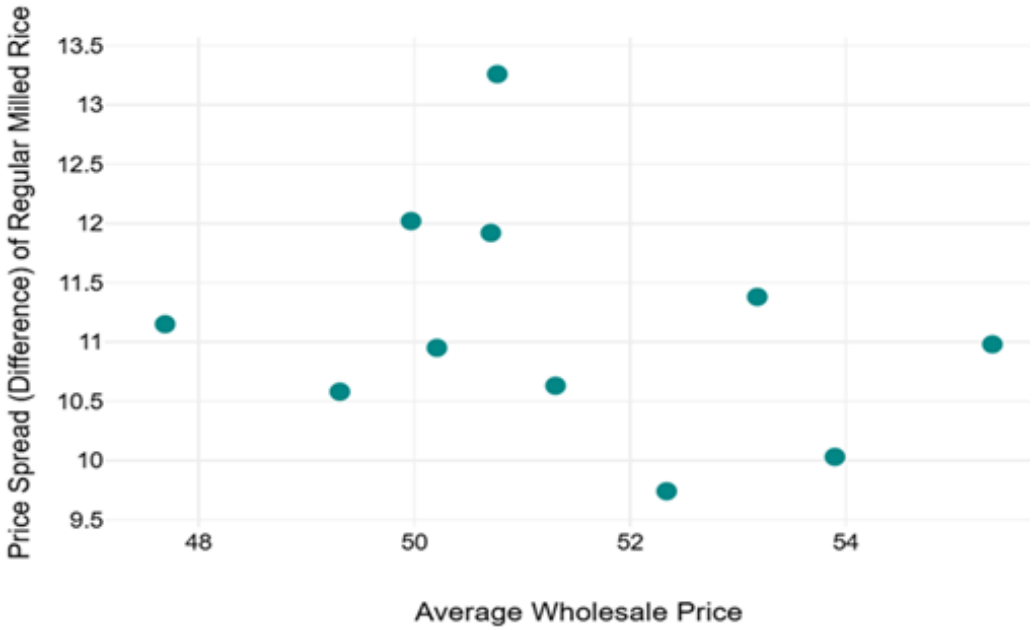

Figure 3. Pearson Correlation Coefficients (r) and P-Values for Average Wholesale Price and Price Regular Milled Rice.

Another Mechanism: Tariff implementations are also an example of government policy that can impact the interaction of rice brands, and the ability for government strategic trade policies to influence domestic rice production is plausible [36]. Product attributes, pricing, and promotion strategies are important factors influencing consumers' buying behavior of locally produced rice [37].

3.7. Analysis of Average Price Spread is Different for Different Rice Grades

This section compares the overall average price spread between Special, Premium, Well Milled, and Regular Milled rice. **Table 13** provides the data to analyze the price differentials by rice grade and geographic location. This information will be used to perform rigorous statistical analyses to test the above hypotheses.

Table 13. Test of Hypothesis: If the Price Spread is Different for Different Rice Grades.

Null Hypothesis	Alternative Hypothesis
There are no differences among the conditions or time points, *Price Spread (Difference) of Rice Special*, *Price Spread (Difference) of Premium Rice*, *Price Spread (Difference) of Well Milled Rice*, and *Price Spread (Difference) of Regular Milled Rice* being compared.	There are differences among the conditions or time points, *Price Spread (Difference) of Rice Special*, *Price Spread (Difference) of Premium Rice*, *Price Spread (Difference) of Well Milled Rice*, and *Price Spread (Difference) of Regular Milled Rice* being compared.

This same analytical methodology would be employed with the other rice grades, so that a full assessment of price dynamics will be calculated. In addition, **Table 14** allows for analysis of price dispersion both within grades across regions and within regions. A deeper analysis is paramount to discover the underlying preferences and structures driving the pricing in the rice market.

Table 14. Test of Hypothesis: If the Price Spread is Different for Different Rice Grades.

Region	Price Spread (Special Rice)	Price Spread (Premium Rice)	Price Spread (Well Milled Rice)	Price Spread (Regular Milled Rice)
Region II	8.07	5.92	5.61	12.02
Region III	7.50	5.50	6.04	10.95
Region IV-A	7.88	5.87	5.87	11.92
MIMAROPA	7.84	5.76	5.55	10.58
Region V	7.89	6.41	6.20	10.03
Region VIII	8.34	6.43	6.39	10.98
Region IX	7.91	6.08	6.27	11.38
Region X	6.78	5.73	5.65	11.15
Region XI	7.72	5.72	6.25	9.74
Region XII	7.68	5.87	6.00	10.63
BARMM	6.67	5.82	6.02	13.26

The observed moderate correlation between Regular Milled rice and wholesale prices signifies that although wholesale prices affect price spreads for lower-grade rice, the extent of this correlation is less than that of higher-grade rice. The differences in findings indicate that rice grade pricing, supply chain, and buying behavior could differ greatly.

The ANOVA results laid out in **Table 15** indicate that the mean price spreads among the different rice grades are statistically significantly different ($F = 25.67$, $p < 0.0001$) with a large η^2 effect size ($\eta^2 = 0.78$). The following pairwise post-hoc tests provide additional evidence. Thus, the price spread for Special rice significantly differed from Premium and Well Milled rice, whilst there was no difference compared with Regular Milled rice. Strangely enough, the price spreads for Premium and Well Milled rice weren't significantly different but significant from the other grades. The striking market disparity indicates diverging rice categories in pricing methodologies, consumer understanding, and mutual market dynamics.

The complexities of rice production can go beyond simply how much the system can produce, as several meteorological factors influence the qualitative and quantitative yield of respective rice varieties [38]. Genetic variation allows for various reactions to meteorological variables, posing difficulties in correlating environmental factors with rice quality [39]. Furthermore, the effects of meteorological factors on the yield of special rice varieties at the grain filling stage have been studied, indicating a significant positive correlation between daily maximum temperature (Tmax) and daily average temperature (Tavg) and yield over certain periods after heading [39]. Notably, developing and promot-

ing new rice varieties should consider consumer preferences for certain rice traits, which seem to belong to aspects other than production, such as plant cycle length, plant height, grain color, elongation/swelling, and tenderness [40]. Breeding rice quality traits is an urgent task to guarantee the consumer's acceptance, given that a variety of rice is exquisite for a specific taste or cook method [41]. It is important to note that rice grading, especially because uniformity in grading criteria used for grading is absent in the various rice-producing zones [42], is directly affected by the customer regarding rice quality and determines the market price of rice.

Table 15. Repeated Measures ANOVA Results.

Source	**F**	**P-Value**	**Partial Eta Squared**	**Interpretation**
Rice Grade	25.67	0.0001	0.78	Significant differences exist
Post-hoc Pairwise Comparisons				
Comparison		Mean Difference	p-value	Interpretation
Special vs. Premium		2.01	0.001	Significant difference
Special vs. Well Milled		2.12	0.001	Significant difference
Special vs. Regular		-4.12	0.0001	Significant difference
Premium vs. Well Milled		0.11	0.75	No significant difference
Premium vs. Regular		-2.11	0.002	Significant difference
Well Milled vs. Regular		-2.22	0.001	Significant difference

Results from the Repeated Measures ANOVA provide unequivocal evidence of statistically significant mean price spreads differing greatly across the individual rice grades ($F = 25.67$, $p < 0.0001$), revealing a very large effect size. Importantly, the subsequent post-hoc pairwise comparisons tell us that the price spread for Special rice is significantly greater than that for Premium and Well Milled rice grades but significantly less than for Regular Milled rice. These compelling data highlight the immense disparity in profit margins among the rice segments, derived from their different position in the market, consumer preferences, and production expenses. The findings have significant implications for industry participants and policymakers alike, aiming to maximize pricing strategies and improve affordability throughout the rice market.

The much larger price gap (greater than the one observed for Special rice) between Regular Milled rice and wholesale rice is possible only because the wholesale price is lower, enabling retailers to apply higher percentage markups. This correlation makes complete sense, as the lower-quality rice varieties are known to have larger price differentials owing to a lower base price and more elastic demand. Branding, however, has a mountain of data on its profitability: it raises purchase intention and allows consumers to tolerate a price premium. In other words, a fair price is one in which the price paid corresponds to the perceived value and quality of the product. In price-sensitive markets, lower grade price elasticity is higher, allowing retailers to generate higher profits and push for upper grades to be collected.

On the other hand, Special Rice's relatively small price range perfectly aligns with its status in the premium segment. As a high-quality product with a higher wholesale price, Special rice leaves less room than lower-quality products for large markups at retail. This follows the generally accepted idea that differences for premium products are smaller since they have high base prices and inelastic demand. Consumers who buy premium rice are paying a premium for quality, which decreases the incentive for a retailer to impose a markup that is too high.

Milling causes substantial changes to the mean sensory characteristics of rice since it removes the bran and germ, which are mainly carbohydrates from the endosperm [43]. This generates a product with a higher glycemic load that may influence glucose homeostasis; nevertheless, it can remain a component of a healthy diet when eaten with different foods [44].

However, the one undeniable proof that the established brands are serving the same market segment (which is the lower end) is the complete mirroring of the price gaps of Premium and Well Milled rice. This highlights the critical role that middle-range rice categories can perform in meeting PSME demands of middle-income consumers in growth niches [7], and the immea-

surable magnitude of this effort. These results seriously impact rice market stakeholders, including policymakers and industry actors. In the lower-quality rice categories, like Regular Milled rice, policies could narrow down the price gaps of these rice categories, making these products much cheaper for consumers facing economic pressure while allowing retailers to obtain reasonable profit margins. Alternatively, it is also possible to subsidize premium rice categories to narrow the price spread between high- and low-quality rice, such that the superior food product becomes as affordable as the food product of inferior quality. Research in the future should investigate the factors driving any gaps in the underlying price spreads (e.g., those linked with the regional origins of production, transport, and final consumption). Consumer brands are also influenced by the cultural environment, social class, purchasing power, motivation, and lifestyle [24]. Rice is a diverse and complex commercial product, and the results highlight important factors driving both consumers and retailers in the rice market.

3.8. Policy Recommendation Plan

The suggested Policy Recommendation Plan provides an overview of a strategy to solve the problems in the Philippine rice market because the current state is still fragmented (**Table 16**), and uninformed price transmission occurs. It is based on the empirical findings of this research and theoretical insights from economics and development. One big piece of the plan is increasing access to market information. Previous studies have explained that current and precise price information represents a basic condition for an effective market process. Indeed, accurate price forecasting is a key component of decision-making in many sectors, particularly in electricity markets. The proposal also urges the Department of Agriculture, the Philippine Statistics Authority, and the Department of Trade and Industry to work with the private sector in creating real-time price information systems. This prior transparency will lead to more informed decisions by all market actors about new transparent systems. In addition, the plan acknowledges the importance of developing infrastructure.

Table 16. Policy Recommendation Plan: Enhancing the Philippine Rice Market.

Policy Recommendation	*Rationale*	*Responsible Agency/Agencies*	*Timeline*	*Expected Outcomes*	*Performance Indicators*
1. Improve Market Information Systems	Lack of timely and accurate price information hinders efficient price transmission and contributes to market segmentation, as producers and consumers are unable to make fully informed decisions. This asymmetry of information can lead to market inefficiencies.	Department of Agriculture (DA), Philippine Statistics Authority (PSA), Department of Trade and Industry (DTI)	Short-term (1–2 years)	Increased transparency in rice pricing at farmgate, wholesale, and retail levels. Improved decision-making by farmers, traders, and consumers. Reduced price volatility.	- Number of regions with publicly accessible, real-time price information platforms. - Frequency of data updates. - User satisfaction surveys (farmers, traders).
2. Invest in Infrastructure Development	High transportation costs and inadequate storage facilities contribute to regional price disparities and postharvest losses, exacerbating market fragmentation as highlighted by the regional price spread variations found in this study. Improved infrastructure is critical for market integration.	DA, Department of Public Works and Highways (DPWH), Local Government Units (LGUs)	Medium-term (3–5 years)	Reduced transportation costs and post harvest losses. Improved market access for farmers. Narrower price spreads between regions.	- Percentage reduction in transportation costs for rice. - Increase in storage capacity. - Reduction in regional price spread variance.
3. Promote Competition and Fair Trade Practices	Market power imbalances (e.g., oligopsony/oligopoly) can distort prices and limit market access for smallholder farmers, as suggested by the strong correlations between wholesale prices and retail spreads for certain rice grades. This aligns with economic theory on imperfect competition.	DTI, Philippine Competition Commission (PCC), DA	Medium-term (3–5 years)	Increased number of market participants. Reduced market concentration. Fairer prices for both producers and consumers.	- Herfindahl-Hirschman Index (HHI) for rice milling and trading. - Number of complaints related to anti-competitive behavior. - Farmer satisfaction with market prices.

Table 16. *Cont.*

Policy Recommendation	*Rationale*	*Responsible Agency/Agencies*	*Timeline*	*Expected Outcomes*	*Performance Indicators*
4. Targeted Support for Vulnerable Consumers	Consumers of Regular Milled rice are particularly vulnerable to price fluctuations and high price spreads, as evidenced by the study's findings. This aligns with work on entitlement and deprivation, where access to food is crucial, especially for low-income households. Targeted interventions can help ensure food security [34].	DA, Department of Social Welfare and Development (DSWD), National Food Authority (NFA)	Short-term (1–2 years)	Improved access to affordable rice for low-income households. Reduced food insecurity among vulnerable populations.	- Number of beneficiaries of targeted rice subsidy programs. - Percentage change in rice consumption among target groups.
5. Strengthen Rice Quality Standards and Grading	Lack of clear and enforced quality standards can contribute to market segmentation and hinder price transmission. Different perceptions of quality can lead to price discrepancies, making it difficult to compare prices across regions and suppliers. Consistent grading allows for better price discovery.	DA-Bureau of Agriculture and Fisheries Standards (BAFS), DTI	Medium-term (3–5 years)	Improved consumer confidence in rice quality. Reduced price discrepancies based on subjective quality assessments. Enhanced competitiveness of Philippine rice.	- Adoption rate of standardized rice grading system. - Number of accredited rice testing laboratories. - Price premium for certified quality rice.
6. Enhance Supply Chain Efficiency	Inefficiencies in the rice supply chain (e.g., multiple intermediaries, lack of coordination) increase costs and contribute to price spreads, as seen in the regional variations in price spreads. Improving coordination among market actors is key to reducing transaction costs.	DA, DTI, LGUs, Private Sector Stakeholders (farmer cooperatives, traders)	Medium-term (3–5 years)	Reduced transaction costs along the supply chain. Improved coordination among market actors. Faster and more efficient movement of rice from farm to market.	- Average time and cost of moving rice from farm to retail. - Number of farmers participating in direct marketing initiatives.
7. Conduct Further Research and Monitoring	Continuous monitoring and evaluation are needed to assess the effectiveness of policy interventions and to identify emerging challenges in the rice market. The study's findings, while insightful, are based on a single year's data and regional averages. Deeper dives into specific regional dynamics and longitudinal studies are crucial.	DA, PSA, Academic Institutions, Research Organizations	Ongoing	Evidence-based policy making. Adaptive management of rice market interventions. Improved understanding of rice market dynamics.	- Number of research studies conducted on rice market dynamics. - Frequency of policy reviews and adjustments.

This paper shows that in a market where different subsections can have 100% or more price differences, infrastructure investments must be very large in scale. Previous studies have increasingly drawn attention to improving transportation and storage facilities to enhance market integration and reduce postharvest losses. Inadequate postharvest infrastructure and logistics have been cited as a primary cause of these losses. It calls for medium-term capital investment by the Department of Agriculture (DA), Department of Public Works and Highways (DPWH), and Local Government Units (LGUs) to lower transportation costs and promote market access for producers located farther from urban areas. This strategic investment will help ameliorate the observed variability in the regional price spreads. The Department of Trade and Industry and the Philippine Competition Commission must proactively ensure competition and fair trade practices in the rice market to break any potential market power imbalances. This entails monitoring market concentration, assessing anticompetitive behavior, and pro-competitive advocacy for new entrants, including smallholder farmers, in the market. Additionally, rice quality standards and grading systems can be strengthened to enhance consumer confidence and address price challenges that reflect subjective quality assessments.

They expand on the proposed strategy well into the current term in their terms, yet there is a competitive environment enforced with the suppliers trading fairly. The research finds that existing imbalances in market power could explain the discrepancies, particularly in the linkage between wholesale and retail prices. This is a well-known feature of imperfectly competitive theories of the economy. Indeed, competition is critical to the proper functioning of all sectors of the economy, as it plays to the firm's advantage in promoting innovation, efficiency, and effectiveness. It thus calls for a closer collaboration among the Department of Trade and Industry, the Philippine Competition Commission, and the Department of Agriculture to tackle market concentration and ensure more balanced pricing for producers and consumers. Enhancing rice quality standards and grading systems is vital, as this would greatly strengthen consumer confidence and eliminate price differences based on subjective quality assessments.

Recognizing the high vulnerability of low-income consumers, especially those dependent on Regular Milled rice, the suggested plan features social assistance as its targeted design. This is consistent with research on entitlement and deprivation and highlights the importance of ensuring access to essential staple food commodities. The short-term interventions' key implementing agencies are the Department of Agriculture, the Department of Social Welfare and Development, and the National Food Authority to mitigate the harmful effects of floating rice prices on vulnerable households and strengthen food security among the most affected population. In addition, the strategy also does more about quality standards. Establishing transparent quality standards and rigorously enforcing them is another vital approach to addressing information asymmetry and facilitating fair competition. Price fairness measures the perceived price difference compared to rivals within the same industry. It supports harmonizing rice standards and classification systems through collaboration between the DA-Bureau of Agriculture and Fisheries Standards and the Department of Trade and Industry to improve consumer confidence and provide a basis for price comparison. Ultimately, the strategy acknowledges inefficiencies that influence the spread between prices in supply chains and calls for better coordination between market participants.

Realizing that inefficiencies in the supply chain cause price spreads, the recommended plan resoundingly supports greater cohesion between parties involved in the markets. In such market scenarios, information asymmetry and misinformation become highly dangerous. They may or may not lead to the nonfunctional operations of individual supply chains and businesses, and affect the whole sector. At this point, the roles of the Department of Agriculture, the Department of Trade and Industry, Local Government Units, and the private sector through their partnership must act with a sense of urgency to cut transaction costs and improve the rice flow from farm to market that will benefit the consumer. Moreover, the continued research and monitoring, a general task involving the DA, the Philippine Statistics Authority, academic institutions, and research organizations, are crucial in evidence-based policymaking and the adaptive management of interventions, especially longitudinal studies. Anything short of that would be a disservice to stakeholders. Certainly, the above recommendation plan provides an expansive and objective strategy concerning the mutability of the Philippine rice market. Its ambitious target to achieve greater efficiency in the rice sector for all stakeholders rests on creating information transparency, infrastructure, competition, consumer protection, quality standards, and supply chain efficiency based on continuous research. A policy environment that firmly tackles the current lack of climate change resilience in the sector is needed to enhance the sector's competitiveness and innovation, and improve export diversification.

Over the previous 4 decades, the Philippines has consistently had a local rice output deficit relative to domestic rice demand, and the country became a net rice importer [45]. This long-standing dependence on imports leaves the Philippines vulnerable to the vagaries of global rice markets, the swings of international prices, and the chances of being cut off from supply lines. As previously mentioned, the Philippine government has enacted these policies and interventions over the years to answer the need to improve the country's rice production [46]. Policies, including the institution of quanti-

tative restrictions on the import of rice, were originally designed to protect the domestic rice industry and offer local farmers the opportunity to improve their competitiveness in the world market [47]. Several rice-importing countries have been laying out their national agro-food policy to be similar: to enhance and consolidate the rice-value chain of home-grown production and minimize reliance on this product by importation [48].

4. Implications of the Study

The study's results can be used to address market inefficiencies in the Philippine rice market and help shape a roadmap of potential reforms. As shown in the study, there is no correlation between wholesale price and palay yield, which confirms that price determinants depend not only on production volume but also transport cost, access to the market, and postharvest handling facilities. The strong positive correlations among spreads between wholesale prices and retail prices for well-milled and premium rice also imply that disproportionate increases in retail prices when wholesale prices rise could affect the availability and affordability of these higher-quality rice to consumers. On the other hand, the pattern of the price spread for ordinary milled rice, which has no significant relationship with the wholesale price, illustrates the unique market features of this fundamental staple and provides evidence of more elastic demand and competition in this segment. The final conclusion is that the observed regional price spread differences for all rice grades reinforce market fragmentation and possible effects from logistical problems or differential regional market power.

5. Conclusions and Recommendations

Segmented markets and imperfect price transmission characterize the Philippine rice sector. Although regional palay production is not a direct component of the expected wholesale price dynamics, wholesale prices are critical to shaping retail price differentials among the different grades of rice, particularly for high-milled and high-quality rice grades. This signals the existence of intermediary factors and market structures that direct how prices are formed. The differential pricing behavior among regular milled rice indicates that this segment may be under separate competitive pressures, which may be responsive to consumer price sensitivity. The overall evidence suggests that the rice market is not fully efficient, represented by regional heterogeneity and differential pricing dynamics by grade. Therein lies the need for product-specific policy interventions to aid market integration and ensure fair prices for all consumers and producers.

A set of recommendations can be given based on the findings of this study. There needs to be a market information system in place. Publishing real-time, region-wise wholesale and retail price data for common crops in the public domain would assist farmers, traders, and consumers make informed decisions. Second, investing in infrastructure, especially in transport and postharvest, would help to narrow region price differentials and losses. Third, competition and fair trade practices policies should be tightened to reduce potential market power imbalances that may generate price distortions. Fourth, there may be a need to support vulnerable consumers, especially those who depend on regular milled rice, to mitigate the impact of price volatility. Finally, it is crucial to conduct continuous research, especially longitudinal studies, to monitor the dynamics of the rice markets and make necessary policy adjustments. Together, the recommendations are intended to harmonize the Philippine rice market, which is more integrated, efficient, and equitable.

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Data Availability Statement

The data presented in this study are available on request from the corresponding author.

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Conflicts of Interest

The author declares no conflict of interest.

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