Dynamics of demand sensitivity for various rice qualities faced by retailers

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Abstract. The pricing behaviour of rice at the retail level needs to receive adequate attention. Rice retailers in retail markets are often assumed to act as price takers, implying that individual rice retailers face a horizontal market demand curve. This study aims to comprehend the demand sensitivity of rice retailers in retail markets before, during, and after the COVID-19 pandemic. This study categorises rice retailers as those operating in traditional or modern markets. Previous studies have not illustrated the changes in demand elasticity that occur over time, as captured in this study. This study utilised rice price data published by the Bank of Indonesia. The research model is based on the theory of optimum pricing at the retail level. Based on this theory, the data were descriptively analysed to identify the patterns of demand sensitivity faced by retailers. The results indicate that the demand sensitivity of rice retailers in traditional markets is higher than that in modern markets. As the quality of the rice sold increases, the demand sensitivity of rice for retailers decreases. The findings of this study are valuable for public policies aimed at controlling rice prices at the retail level in Indonesia.

1 Introduction

Rice is still a significant component of household expenditure on food, especially in low-income households [1]. The important role of rice in expenditure influences household behaviour in allocating its budget. If there are changes in household income, rice prices, or other food prices, these changes will be reflected in household demand for rice. Various studies have shown that the market demand for rice has low elasticity or sensitivity to price changes [2]. Market demand is insensitive to price changes, resulting in high price fluctuations when supply side shocks occur. Fluctuations in rice prices caused by shocks on the supply side are what the government has always tried to dampen through rice price stabilisation policies. Rice prices in the international market [3]. Based on FAO data [4], rice prices at the international level increased by 3% from January to September 2023. This is lower than the increase in rice prices in Indonesia during the same period, which amounted to 12%. Rice prices in Indonesia tend to be higher than those at the international level for several reasons, including higher production costs and the government's policy of setting a minimum price for rice.

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The success of the food price stabilisation policy is determined by the response of households to their demand for food and the response of rice producers and marketers from upstream to downstream [5]. Food traders at the retail level directly deal with end consumers. Various studies show that retail traders do not fully act as price takers [6,7]. Food traders at the retail level can implement pricing strategies [8].

At the retail level, the food market structure is not perfectly competitive. To a certain degree, food traders in the retail market set prices above or below market prices, especially in the short-term and in local markets [9]. As non-price takers, each trader at the retail level faces a non-horizontal demand curve. Likewise, traded food is not homogeneous but differentiated with different qualities [10]. Food traders compete in market locations. The price of goods determined by retail traders is not only determined by the reactions of competing retailers or by the quality of the goods sold, but also by changes in demand they face [11–13].

This study aims to analyse the dynamics of consumer sensitivity to price changes, as indicated by the elasticity value of demand for rice. Various studies on rice demand have been conducted through direct demand analysis at the household level [2,14–17]. The novelty of this research arises from the approach used to analyse the dynamics of changes in rice demand sensitivity at the consumer level. In previous studies, changes in demand sensitivity to the price of the goods themselves were derived from an analysis of consumer behaviour using data at the household level. The estimation methods applied in previous research and the use of household-level data also make it impossible to capture the dynamics of the changes in household demand sensitivity. Researchers have had difficulty empirically estimating elasticity changes since Harmston and Hino [18] worked on the evolution of demand elasticity. In contrast, the approach used in this study captures the dynamics or changes in the sensitivity of household demand. This study strengthens the results of previous research that food traders at the retail level do not fully act as price takers because the demand they face is not perfectly elastic.

This study deduces changes in the sensitivity of rice demand through changes in the marketing margins between the retail and wholesale markets. Theoretically, changes in marketing margins are not caused only by increases or decreases in marketing costs. However, they are also due to increases or decreases in the profit margins taken by retail traders. The profit margin obtained is determined by the retail trader's ability to consider the elasticity of demand. Knowledge of the dynamics of rice consumer demand sensitivity faced by retail traders is important in formulating appropriate and effective rice price stabilisation policies.

2 Methodology

2.1 Theoretical background

This study employed a deductive-descriptive approach, in which the sensitivity of consumer demand for rice was not derived directly through analysis of decision-making at the consumer level, but through price decisions made by traders at the retail level. The assumption underlying price decisions at the retail level is that traders aim to maximise profits. The profits earned by retailers can be written as

\[ \pi = TR(q) - TC(q) \]  

(1)
where \( \pi \) is the profit, \( TR(q) \) is the total revenue, and \( TC(q) \) is the total cost influenced by the quantity of products produced. The maximum profit is obtained under the following conditions:

\[
MR(q) = MC(q) \tag{2}
\]

where \( MR(q) \) is the marginal revenue and \( MC(q) \) is the marginal cost. \( MR(q) \) is derived from \( TR(q) \) to obtain the expression \( MR(q) \) with the elasticity of demand:

\[
MR(q) = P(1 + \frac{1}{\varepsilon_p}) \tag{3}
\]

where \( P \) is the selling price of the product and \( \varepsilon_p \) is the own price elasticity. The following equation is obtained by replacing \( MR(q) \) with \( MC(q) \):

\[
P = MC(q) \left( \frac{1}{1+\varepsilon_p} \right) \tag{4}
\]

Equation (4), with simple mathematical manipulation, can be changed to

\[
\frac{P-MC(q)}{P} = -\frac{1}{\varepsilon_p} \tag{5}
\]

where \( P-MC(q) \) is the profit margin obtained by the retailer, and the expression \( \frac{P-MC(q)}{P} \) is the markup on the price. Thus, it can be stated that the determination of the markup on price by retailers is influenced by the amount of demand elasticity they face. In other words, the elasticity or sensitivity of demand faced by retail traders can be estimated from the amount of markup on the price set by retail traders.

### 2.2 Source of data and steps of data analysis

This study used secondary data obtained from the National Strategic Food Price Information Center (PIHPS) published by Bank Indonesia. The data taken from the PIHPS are rice price data at the wholesale level and rice prices at the retail level. Rice prices were categorised based on quality: low grade I, low grade II, medium grade I, medium grade II, super grade I, and super grade II. Market prices at the retail level and prices for various qualities of rice were also categorised into prices in traditional and modern markets. The price data were daily price data covering three timeframes: before the COVID-19 pandemic, during the COVID-19 pandemic (31 March 2020–29 December 2022), and after the COVID-19 pandemic was officially declared (30 December 2022).

Data analysis was performed in three steps. The first step was to calculate the marketing margin between the retail and wholesale levels, which is the difference between the prices at the retail and wholesale levels. The margin between these two market levels includes marketing cost and profit margin. However, in this research, the separation of the two components of the marketing margin cannot be done directly because the data available in the PIHPS were prices at the retail level and prices at the wholesale level. The second step was to calculate the profit margin (%) earned by rice traders at the retail level. The profit margin calculation was based on secondary data from previous studies, especially those discussing rice marketing margins along the market chain from the producer to the retail level. The third step used the calculation results in the second step to sort out the part of the
marketing margin resulting from the first step, which is the profit margin component. Then, based on the formula in Equation (5), the elasticity of demand for rice was estimated at the retail level.

The main weakness of the method used in this study is the absence of marketing cost data. It is estimated that marketing costs will be affected by the conditions before, during, and after COVID-19. Marketing costs change, especially in the transportation cost component, due to the Large-Scale Social Restrictions (PSBB) policy. The calculation results using the optimal pricing model at the retail level will be more precise if marketing cost data are obtained, and this certainly requires a study at the micro level (retailers). However, this study still captures intertemporal changes in the magnitude of rice demand sensitivity.

3 Results and discussion

The first step of this research was to analyse marketing margins. Table 1 presents the marketing margin between the retail and wholesale levels obtained by subtracting the price of rice at the retail level from the price at the wholesale level. The marketing margin between modern retail and wholesale markets is consistently more significant than that between traditional and wholesale markets. Marketing margins in modern markets are higher than those in traditional markets across all qualities of rice and in all timeframes before, during, and after the COVID-19 pandemic. One reason marketing margins in modern markets are higher than those in traditional markets is the higher profit margins. The variable cost components between the two markets were estimated to not differ significantly because modern and traditional retail retailers face the same wholesaler market.

Marketing margins in modern markets showed a decreasing trend before, during, and after the COVID-19 pandemic. At the same time, the decline in marketing margins was apparent in traditional markets after the COVID-19 pandemic. Marketing margins for low-quality rice in traditional and modern markets are higher than those for medium- and super-grade rice. The higher margins in the medium- and super-grade rice markets were thought to be caused by marketing strategies for medium- and super-grade rice, which require higher costs and the opportunity to obtain higher profit margins.

Table 1. Rice marketing margin based on market category and rice quality before, during, and after the COVID-19 pandemic (IDR/kg).

<table>
<thead>
<tr>
<th>Rice quality</th>
<th>Traditional market</th>
<th>Modern market</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before pandemic</td>
<td>During pandemic</td>
</tr>
<tr>
<td>Low grade I</td>
<td>707</td>
<td>747</td>
</tr>
<tr>
<td>Low grade II</td>
<td>546</td>
<td>596</td>
</tr>
<tr>
<td>Medium grade I</td>
<td>806</td>
<td>852</td>
</tr>
<tr>
<td>Medium grade II</td>
<td>829</td>
<td>835</td>
</tr>
<tr>
<td>Super grade I</td>
<td>857</td>
<td>863</td>
</tr>
<tr>
<td>Super grade II</td>
<td>738</td>
<td>811</td>
</tr>
</tbody>
</table>

Source: [19]

Before calculating the demand elasticity faced by rice traders at the retail level, it was necessary to first determine the profit margin obtained by these retail traders. The profit margin in this study was obtained from previous studies. As these studies were case studies, the profit margin used in this study was obtained from the average value of all the case studies employed. Table 2 presents the average profit margin obtained by rice traders at the retail level, which is 78.96% of the marketing margin between the retail and wholesale levels.
Table 2. Reference of previous studies used to calculate the profit margin component in rice marketing margin between the retail and wholesale levels.

<table>
<thead>
<tr>
<th>Data source</th>
<th>Marketing margin (IDR/kg)</th>
<th>Profit (IDR/kg)</th>
<th>Profit margin (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice marketing system in Banyuasin District [20]</td>
<td>500</td>
<td>285.71</td>
<td>57.14</td>
</tr>
<tr>
<td>Analysis of the marketing system of Ciherang rice in Cianjur District [21]</td>
<td>300</td>
<td>200</td>
<td>66.67</td>
</tr>
<tr>
<td>Analysis of the marketing chain of IR 64 rice [22]</td>
<td>200</td>
<td>179</td>
<td>89.50</td>
</tr>
<tr>
<td>Rice marketing system in Ogan Komering Ulu Timur District [23]</td>
<td>1,300</td>
<td>784.33</td>
<td>60.33</td>
</tr>
<tr>
<td>Farm and marketing analysis of Pandan Wangi variety of rice in Cianjur District [24]</td>
<td>1,400</td>
<td>1,300</td>
<td>92.86</td>
</tr>
<tr>
<td>Analysis of rice marketing in Demak District [25]</td>
<td>200</td>
<td>185</td>
<td>92.50</td>
</tr>
<tr>
<td>Analysis of farm income, marketing, and consumers' perception toward organic rice [26]</td>
<td>2,100</td>
<td>1,820</td>
<td>86.67</td>
</tr>
<tr>
<td>Analysis of marketing of Ciherang rice variety in Bogor District [27]</td>
<td>300</td>
<td>255</td>
<td>85.00</td>
</tr>
<tr>
<td>Rice marketing system in Landak District, West Borneo [28]</td>
<td>1,500</td>
<td>1,200</td>
<td>80.00</td>
</tr>
<tr>
<td>Average of profit margin (%)</td>
<td></td>
<td></td>
<td>78.96</td>
</tr>
</tbody>
</table>

The percentage of profit margin obtained from previous case studies in Indonesia was then used to estimate the profit margin obtained by rice retailers based on the price data published by PIHPS. The elasticity of demand faced by rice retailers is obtained by applying Equation (5). Table 3 presents the results of calculating the elasticity of demand for rice of various qualities at the retail level in traditional and modern markets before, during, and after the COVID-19 pandemic. For all qualities, the elasticity of demand faced by retail traders in modern markets was lower than that faced by retailers in traditional ones. The lower elasticity of demand faced by rice traders in modern than in traditional markets also reflects the research results that show consumer perceptions that the goods sold in modern markets are of higher quality than those sold in traditional markets [29,30]. Rice consumers in traditional markets are also more sensitive to price changes than are consumers in modern markets. Consumers who shop in modern markets tend to have higher income levels than those who shop in traditional markets [31,32]. In general, the higher the consumer's income, the less sensitive the consumer is to changes in food prices.

Table 3. Own price elasticity of demand for rice based on market category and rice quality before, during, and after the COVID-19 pandemic.

<table>
<thead>
<tr>
<th>Rice quality</th>
<th>Traditional market</th>
<th>Modern market</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before pandemic</td>
<td>During pandemic</td>
</tr>
<tr>
<td>Low grade I</td>
<td>15.15</td>
<td>14.49</td>
</tr>
<tr>
<td>Low grade II</td>
<td>18.92</td>
<td>17.59</td>
</tr>
<tr>
<td>Medium grade I</td>
<td>14.67</td>
<td>13.94</td>
</tr>
<tr>
<td>Medium grade II</td>
<td>14.03</td>
<td>13.96</td>
</tr>
<tr>
<td>Super grade I</td>
<td>15.26</td>
<td>15.25</td>
</tr>
<tr>
<td>Super grade II</td>
<td>17.12</td>
<td>15.73</td>
</tr>
</tbody>
</table>

Source: [19]
Table 3 shows that the higher the quality of rice retailers sell in traditional and modern markets, the less elastic is the demand. The marketing margin (Table 1) shows that the higher the quality of rice, the greater the marketing margin. One component of marketing margin was the profit margin obtained by retail traders. The less sensitive consumers are to price changes, the greater the opportunity for retail traders to increase the profit margin they receive. This is also reflected in Table 2, where retailers selling Pandan Wangi rice earned relatively higher profit margins for other varieties considered lower quality rice.

Table 3 also presents the elasticity of demand for rice of all qualities in the modern market, showing a magnitude that continued to increase before, during, and after the COVID-19 pandemic. Even though the elasticity value is still lower than the elasticity of demand in traditional markets, the increase in demand elasticity in the modern market was relatively significant. The COVID-19 pandemic has negatively affected the economy of middle-class households. The rise in demand elasticity in the modern market provides evidence that middle-income consumers are becoming increasingly sensitive to changes in food prices. High-income consumers are less likely to react to price changes but more likely to respond to cross-price changes than low-income consumers [33]. Increasing consumer price sensitivity in the modern market has made it increasingly difficult for rice retailers to expand their profit margins. Retailers tend to implement a price-averaging strategy to deal with increased price volatility [34]. The problem of pricing at the retail level is made more complex by the existence of rice price linkages between qualities. Research by Utami et al. [35] found that quality prices show a strong price relationship between premium and medium-quality rice and between medium- and low-quality rice. Food consumers, who are increasingly sensitive to changes in rice prices, might also signal to the government to maintain rice price stability and all rice qualities in modern and traditional markets.

4 Conclusions and policy recommendations

The demand faced by rice traders at the retail level in modern and traditional markets is relatively price-sensitive. The high elasticity of demand confronted by each rice trader at the retail level indicates high market competition. In the modern market, the price sensitivity of rice demand tends to be lower for higher-quality rice. Meanwhile, in the traditional market, medium-quality rice has a relatively lower demand elasticity than low- and high-grade rice, and if mapped, it appears as a U-curve. The COVID-19 pandemic has affected the price sensitivity of rice demand. The demand for rice faced by retail traders in modern markets is becoming increasingly sensitive to price changes for all types and qualities of rice.

The demand for rice, which is increasingly sensitive to price changes, indicates the increasing importance of public policies that maintain the stability of rice prices at the retail level. To determine the price policy at the retailer level, it is necessary to consider the difference in the quality of rice in traditional and modern markets. Based on this research, modern market consumers who tend to buy super-grade quality rice may switch to buying lower-quality rice. This may increase the price of lower-quality rice. Detailed research at the micro level using primary data is needed to ensure the robustness of the elasticity figures found in this study, especially regarding the marketing costs between wholesalers and retailers.

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