Understanding Indonesian Most Strategic Food Consumption Pattern and Welfare Impact of Price Increase Events

A household microdata analysis

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Abstract

The study's principal aims are to understand the Indonesian most strategic food consumption pattern and to calculate the welfare impact of recent price increase events. The food classification used in this study is Indonesia's most strategic food including rice, chicken meat, beef, chicken egg, shallot, garlic, chili, fish, cooking oil, white sugar, flour; plus, additional classification including processed food and beverages and other food items. Data employed in this study are 2018 national socio-economic survey from Indonesia Statistical Agency. The data covers household consumption and demographic variables, representing all Indonesian households. This study accounts the heterogeneity across Indonesian region by estimating QUAIDS for five regional classifications: Sumatera, Java-Bali, Kalimantan, Sulawesi, and Nusa Tenggara-Maluku-Papua (Nusmapua). This study found that regional heterogeneity plays an important role in explaining the most strategic food consumption pattern in Indonesia. The welfare impact from two price increase events is estimated and found to be vary across regions.

Keywords: quaids, Indonesia most strategic food, elasticities, welfare impact

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Abbreviations

AIDS	Almost Ideal Demand System
Bappenas	*Badan Perencanaan Pembangunan Nasional*/ Indonesia National Development Planning Agency
Nusmapua	*Nusa Tenggara, Maluku, and Papua*
PIGLOG	Price Independent Generalized Logarithmic
PIHPS	*Pusat Informasi Harga Pangan Strategis*/ Strategic Food Price Information Center
QUAIDS	Quadratic Almost Ideal Demand System
SUSENAS	*Survey Sosial Ekonomi Nasional*/ National Socio-Economic Survey
TPIN	*Tim Pengendalian Inflasi Nasional*/ National Inflation Management Team

1. Introduction

The study's principal aims are identifying Indonesian most strategic food consumption pattern and calculating the welfare impact of food price increase events. The main contributions of this study are: 1) it accounts for heterogeneity across Indonesia's regions, 2) it provides more specific commodity grouping defined as Indonesia most strategic commodities, 3) it employs newer household microdata, and 4) it discuss the welfare impact measurement of recent price increase events. The results from this study are meant to give the reader information about recent food consumption patterns in Indonesia in general or more specifically policy makers at government bodies or agricultural related firms in managing some agricultural products.

This study fulfils the gaps in former studies by considering the Indonesia's most strategic food commodities and furthermore, accounting for regional heterogeneity by calculating different demand systems for the five regions for the first time. Indonesia most strategic food commodities are identified in Presidential Decree 2015 Number 71 (-, 2015) which includes rice, chicken meat, beef, chicken egg, shallot, garlic, chili, fish, cooking oil, white sugar, and flour. Basically, the determination of these 11 specific food commodities is based on its importance for average Indonesian household to support their livelihood. Studying these specific commodities might be important for policy consideration because while the commodities are defined as strategic but there is no clear direction for how each commodity should be managed, especially in different regional setting. One commodity that already well managed is rice as the state rice institution (BULOG) take an active role in the market since early development phase (Timmer, 1996). Therefore, the result from this study may help to answers questions such as should the price of other strategic commodities be controlled and how the society benefited from such action? as it may generate budget consequences to control commodity price especially when other commodities are relatively harder to stay long in the warehouse.

The consideration of regional heterogeneity in this study is not only important from empirical point of view but can also become practical policy evaluation tool. Empirical issue of accounting regional heterogeneity for study in Indonesia is already raised in previous studies such as Deaton (1990) and more recently

Widarjono and Rucbha (2016) that specifically recommends further research to account for regional heterogeneity. More than that, this consideration can also be useful as practical policy evaluation tool that may lead to practical policy implications as decentralization policy in Indonesia allows regional government to make complementary policy that affect food consumption and/or prices. Therefore, this study investigates this heterogeneity while make a hypothesis that it has an important role in altering the consumption pattern. Along with this hypothesis, other four hypotheses related to food consumption pattern are derived from the suggestions found in literature.

Further, this study provides one of practical use of estimated elasticities by calculating welfare impact of recent food price increase events in Indonesia. These events include the cooking oil price increase in early 2022 and general commodity price increase during 2019 Eid celebration. The determination of these two events is arbitrarily but this study shows that they can be a good comparison for discussion because the former is occasional unexpected event while the latter is frequent yearly event. Welfare impact is estimated using recent acceptable method in agricultural and food policy discussion. Therefore, one more hypothesis is derived, and it expect the price increase events can generate various welfare impact across regions.

The rest of this study is organized as follow: Chapter 2 presents the background of this study, Chapter 3 presents theoretical framework and literature review which includes the statement of the hypotheses, Chapter 4 presents the method used to estimate consumption pattern and welfare impact of price increase, Chapter 5 presents the data employed, empirical model specification, welfare impact measurement, and price increase events description, Chapter 6 presents the estimation results, estimated elasticities, welfare impact, and each followed by brief discussion, then Chapter 7 concludes.

2. Background

The study of food consumption pattern is not only attracting in Indonesia; however, it has been extensively studied in many countries. There is a long line of research in studying consumption pattern for example Working (1943) until recently Brauw and Herskowitz (2021) that respectively observe household consumption in general and processed food consumption pattern. It is also found for Indonesia as a specific case for example Boediono (1978), Teklu and Johnson (1987), Deaton (1990), Widarjono and Rucbha (2016), Faharuddin *et al.*, (2017), Nikmatul *et al.*, (2020). Along this line of study, not only the year of observation that differ but also variation in background, method, and estimated elasticities for the same good are found (for example price elasticity of rice is -0.63 in Boediono, -0.42 in Deaton, and -0.50 in Faharuddin).

The variation in the background along the line of consumption pattern studies might show us that understanding consumption pattern can be important for every stage of development, not just in early development phase. The background of early research is found to be more focused on how to understand the pattern by proposing various method and discuss how it performed, while most recent study tried to answer some questions such as undernutrition, overweight, general health, and environmental issue (Abdulai, 2002; Grabs, 2015; Säll and Gren, 2015; Roosen, Staudigel and Rahbauer, 2022). These studies are mostly not only identifying the consumption pattern but also estimating how price changes through tax scenarios may change the demand structure. These kinds of studies are found many, but it is still limited within Indonesian context.

Food consumption pattern study in Indonesia is not only limited because of a long year gap, method employed, but also further discussion on how it can be used to evaluate the effects of price changes. Fulfilling the first two limitations only may still be fruitful as it can presents the estimated pattern and then it may be used to calculate the impact of price changes, or it may be used for observing how the pattern change overtime by looking at the results from available studies. Further, fulfilling the last limitation can give an interesting point of the study in Indonesia because policies related to food are found many. This is because food sector is still having an important role in the economy.

The reason why policymakers in Indonesia put a huge concern on food is that it is important both for the demand and supply side of the economy. The concern from demand side is because both the economy and population are growing, while land as one of food production factors is limited. These forces might put pressure on food availability and consumer affordability, which may lead to political instability.

The other reason is because 28 percent Indonesian worker employed in agricultural sector and there will be more if it includes worker employed in food industry, food trading, and restaurant. The importance of food is truly reflected in Indonesian consumer spending on food that is still considerably high at 49 percent in 2021 (Statistics Indonesia, 2021). While the worry about food availability proved to be wrong in many cases as there is technological progress, this picture may still show that food consumption is an important instrument for Indonesia development strategy. Therefore, it attracts many scholars to study food consumption pattern in Indonesia as it may help policy making process.

3. Theoretical Framework and Literature Review

Theoretical prediction of food consumption pattern is going back to Engel's law. This law state that the share of income for food decreases as income rises. Deaton (2010) states that this law attempts/can use food consumption to make inferences/assumptions about living standards. Inferences can be done because as individual income rose, they will start to consume other goods or services to maximize their utility as theoretically formulated by Matsuyama (2002). This process can also explain the process of economic development and it is defined as "general transformation model" in Johnston and Mellor (1961). It states that when the income elasticity of food is less than one and declining, then it allows labour expansion from agricultural sector to another sector. Therefore, the first hypothesis for this study is:

- *Hypothesis 1: income elasticities of food are less than non-food items*

The main point of this study is not only to identify food consumption patterns as all food items aggregated to one food group, but also the individual food items defined as Indonesian most strategic food. The aggregate food is the whole household consumption categorized as food including cereals, fish, meat, eggs, milk, vegetables, fruit, oils, fats, prepared food, prepared drinks, tobacco, and other foods. Meanwhile, the disaggregated food groups are rice, meat (including both, chicken and beef), egg, shallot, garlic, chili, fish, cooking oil, white sugar, flour, processed foods and beverages, and other food items. The details on this classification can be found in Appendix 1.

Considering the theoretical formulation of Matsuyama (2002) and historical experience on food consumption pattern in Grigg (1995) and Collantes (2019), there might be a variation in pattern within food classifications itself. This variation can exist because at certain income levels some food items can be categorized as more luxurious than another. For example, historical experience in Western European countries show that consumption changed from starchy staples-based goods into consuming more livestock products as income rose. Therefore, variation in pattern within food classification itself can be expected as consumer may consider some food products to be more luxurious than another.

- *Hypothesis 2: there is elasticity variation across different food classifications*

Additionally, Bils and Klenow (2001) developed a theory that can be used to explain food consumption pattern. This theory explains how an increase of food variety can shift consumers spending from relatively static type of foods to relatively more dynamic type of food. This theory says that when the variability of one good is higher than of another good consumer will increase their consumption of the former when their income rises. Pattern like that can be expected from Indonesia urban area especially the capital Jakarta where new types of food are often introduced, exposing Indonesia's and World's huge food culture heritage. Brauw and Herskowitz (2021) do not specifically discuss an increasing food variety, but they show this pattern in Nigeria as they found an increasing demand for food consumed away from home. Therefore, as food become increasingly varied there is a possibility that it becomes a new luxury at some income level. This theory might explain an increasing consumer food expenditure share or keeping total food expenditure share high even they relatively have high income.

The other source of increasing food variety is the rise of food manufacturing activities. These activities stimulate the development of new food varieties which suit many consumers specific needs and wants. Food manufacturer may also exploit consumers awareness on something to attract consumer with higher income to buy additional services that come with the food, for example in Indonesia it could be halal awareness, health, and environmental. More than that, the activity also allows some food to be preserved and distributed across huge area. Therefore, it can increase food availability and variability at a moment in every region that induce consumer to shift between food variety when their income rises.

- *Hypothesis 3: other food items and processed food-beverages classifications have higher income elasticity than other food classifications.*

Other aspects that might affect food consumption pattern is household demographics such as household size, age, urban/rural location, and education. Empirically speaking, these demographics variables are usually used as control in previous similar studies for example Deaton (1990), Abdulai (2002), Wang and Çakır (2021), and Roosen, Staudigel and Rahbauer (2022). However, it is not usually discussed extensively in such studies. There is a study by Deaton and Paxson (1998) that extensively discuss the role of household size both theoretically and empirically. It is explained that household size might have effect to consumption as it changes the shape of household budget constraint and utility function. Therefore, it can be expected that other demographic variables might play important role in household constraint or utility function so that it affects household consumption behaviour, for example educated household on average may have additional constraint in their consumption decision or put different weight between certain type of food.

- *Hypothesis 4: household demographic variables (household size, age, and education) affect household consumption behaviour.*

Previous studies are mostly found to support this study first four hypotheses both for one that make Indonesia as specific case or different country cases. The first hypothesis is widely accepted and there are numerous studies that support this for example Boediono (1978) and Jensen and Manrique (1998) for their study in Indonesia, Abdulai (2002) for Switzerland, and Nsabimana *et al.*, (2020) for Rwanda. These studies are not only discussed about food and non-food classifications but also more detailed food classifications as most other studies did by disregards conditional and unconditional elasticities, for example Timmer and Alderman (1979), Teklu and Johnson (1987), Rachmat and Erwidodo (1993), Pangaribowo and Tsegai (2011), Saliem (2016), Faharuddin *et al.* (2017), Nikmatul *et al.* (2020), and Wang and Çakır (2021). All studies found a variation in elasticities between each food classifications considered even in the inside of specific groups such as staples and livestock, moreover some studies in Indonesia found that rice usually less elastic than other food classifications, while processed food is found to be more elastic. Most studies are considering household demographics into their demand system and found significant coefficients; however, they are not specifically discussing about it.

Regional heterogeneity is another aspect that this study considers having some effect on consumption pattern. This is because different regional setting is expected to generate many unobserved differences that affect consumption pattern. Moreover, the difference in consumer taste across region is also expected to be the one of unobserved difference that can affect consumption pattern, for example some region used maize as their main staple as identified by Myers *et al.*, (2014) or other alternative such as cassava, certain roots, and sago. Regional heterogeneity issue in Indonesia is already discussed in previous studies for example Deaton (1990) and Widarjono and Rucbha (2016), thus it suggest further study to consider this regional heterogeneity.

Deaton (1990) mention about the possibility of regional heterogeneity so he avoids the problem by taking only household sample from Java, then Widarjono and Rucbha (2016) found significant difference in food consumption pattern between household in urban Java and urban off-Java. Regional heterogeneity is not only discussed in Indonesia specific study but some studies also found it in another countries for example Brauw and Herskowitz (2021) in Nigeria. Some Indonesia specific studies are already consider regional heterogeneity by including urban/rural dummy and some consider provincial dummy into their demand system such as Jensen and Manrique (1998) and Saliem (2016), however no previous study that estimate the demand system by each region separately and specifically discuss the results.

Practical policy tool and implication is also expected by considering regional heterogeneity. This is because Indonesia implements decentralization policy that effective since January 2001. This policy allows regional government to take various policies that can affect commodity prices. There is also a collaborative effort from Indonesian government with central bank that have specific task for prices management both at national and regional level called *Tim Pengendalian Inflasi Nasional* (TPIN) or National Inflation Management Team. The newest Government of Indonesia work plan have also considered development strategy by region according to Bappenas (2021). Therefore, it might be useful to understand consumption pattern at each regional level because it can allow welfare analysis such as one done by Ma, Lin and Sexton (2022) or Azzam and Rettab (2012), Widarjono and Rucbha (2016), Wang and Çakır (2021), and Roosen, Staudigel and Rahbauer (2022) for various policy that affect food prices at regional level. It is also important because there might be different welfare impact for the same type of policy across different regions.

- *Hypothesis 5: there is elasticities difference across regions.*

The next step of this study is the welfare impact estimation of recent food price increase events based on estimated elasticities for each region. The concept of welfare can be referred to the concept of consumer surplus or the area under the demand curve. This simple concept predicts that a welfare effect from price increase can be calculated using the difference in area under demand curve before and after price increase. The area after the price increase should be smaller because the slope of demand curve is negative, therefore there will be negative welfare impact from price increase. Moreover, the size different between before and after price increase will depend on the curvature of the demand which measured by the elasticity that is expected to be varied across regions.

Hypothesis 6: welfare effects from price increase events varied across regions.

4. Method

This section presents the strategy used to measure elasticities and how to use it for measuring compensating variation (CV).

4.1 Demand System

This section explains the demand system method used in this study and the assumption behind this method.

4.1.1 An Almost Ideal Demand System (AIDS)

The AIDS model is developed by Deaton and Muellbauer (1980). This model is superior to the previous known models because it poses the properties of both Translog and Rotterdam models at the same time. This model has been widely applied in empirical study since its development and has been extended by Banks, Blundell and Lewbel (1997) to accommodate non-linear Engel's curve. It is well known as Quadratic AIDS (QUAIDS). Barnett and Seck (2008) show that this model can outperform the Rotterdam model, especially when more detailed commodity grouping is used.

It is not surprising that this method is more popular than other demand system. Other reason for this method popularity is the availability of computing power and software that can handle linear or non-linear version of AIDS for example program developed in Stata by Poi (2012), Lecocq and Robin (2015), and Caro *et al.*, (2021), also program developed in other software such as R by Henningsen (2017), therefore many studies implement this method. More than that, this is also show that the method is still acceptable until recently for example Wang and Çakır (2021) and Roosen, Staudigel and Rahbauer (2022), also among studies that specifically discuss about consumption pattern in Indonesia for example Widarjono and Rucbha (2016), Faharuddin *et al.*, (2019), and Nikmatul *et al.*, (2020).

The implementation of the method is found many in previous food demand studies, but not only limited to it (for example Ngui *et al.*, 2011 implement it for energy demand analysis). Some studies use the method to interpret the elasticity for example Abdulai (2002) explain Switzerland household food demand, Nikmatul *et* *al.*, (2020) explain Indonesian household livestock demand, and Faharuddin *et al.*, (2017) explain Indonesian household food and nutrient demand. Other studies use this method not only to explain the elasticity but also use it for calculating the impact of price changes for example Roosen, Staudigel and Rahbauer (2022) measure the welfare impact from meat tax on German consumers, Säll and Gren (2015) measure the environmental impact of meat and dairy tax on Sweden consumers, Wang and Çakır (2021) measure the welfare impact of teff price increase on Ethiopian consumers, and Azzam and Rettab (2012) measure the welfare impact of rising food prices on UAE consumers.

The QUAIDS model share the same properties as AIDS, and it allows goods to be luxuries at some levels of income and necessities at higher level. This model uses the same PIGLOG preference as original AIDS model. The model uses the same expenditure share as independent variable,

$$(4.1) \qquad w_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} \ln p_j + \beta_i \ln\left(\frac{m}{a(\boldsymbol{p})}\right) + \frac{\lambda_i}{b(\boldsymbol{p})}\left(\ln\left(\frac{m}{a(\boldsymbol{p})}\right)\right)^2$$

where,

$$(4.2) \qquad \ln a(\boldsymbol{p}) = \alpha_0 + \sum_{i=1}^{n} \alpha_i \ln p_i + \frac{1}{2} \sum_{i=1}^{n} \sum_{j=1}^{n} \gamma_{ij} \ln p_i \ln p_j$$

and

$$(4.3) \qquad b(\boldsymbol{p}) = \prod_{i=1}^{n} p_i^{\beta_i}$$

The model has the same properties with original AIDS model except the quadratic term allows more flexible Engel curve shapes. The impact of demographic and other household characteristics could be allowed to enter all terms. The elasticities can be calculated by differentiate equation (4.1) with respect to $\ln m$ and $\ln p_j$ to obtain,

$$(4.4) \qquad \mu_i = \frac{\delta w_i}{\delta \ln m} = \beta_i + \frac{2\lambda_i}{b(\boldsymbol{p})}\left(\ln\left(\frac{m}{a(\boldsymbol{p})}\right)\right)$$

$$(4.5) \qquad \mu_{ij} = \frac{\delta w_i}{\delta \ln p_j} = \gamma_{ij} - \mu_i\left(a_j + \sum_k \gamma_{jk} \ln P_k\right) - \frac{\lambda_i \beta_j}{b(\boldsymbol{p})}\left(\ln\left(\frac{m}{b(\boldsymbol{p})}\right)\right)^2$$

The budget elasticities then calculated as,

$$(4.6) \qquad e_i = \frac{\mu_i}{w_i} + 1$$

while uncompensated and compensated price elasticities respectively are,

$$(4.7) \qquad e_{ij}^u = \frac{\mu_{ij}}{w_i} - \delta_{ij}$$

$$e_{ij}^{c} = e_{ij}^{u} + e_i w_j \tag{4.8}$$

4.1.2 Weak Separability and Price Indices

This study implements two-stage budgeting procedure to estimate the elasticities for several food classifications, therefore it is important to note that this study is based on two assumptions. The first assumption is weak separability, which assume two independent steps of consumer budget allocation. The other assumption is the price indices produced by the aggregation of several commodities is nearly as good as ideal price indices. These assumptions are important to conclude the elasticities produced in this study is a consistent approximation of true elasticities as discussed in Edgerton (1997).

4.2 Welfare Effects Measurement

There are three measures in microeconomic analysis used to measure welfare effect: compensating variation (CV), equivalent variation (EV), and consumer surplus (CS). The measurement employed in this study is the measure of compensating variation (CV) because it measures how much consumer willing to accept to restore their utility level after price increase or how much consumer willing to pay by the same utility level as price decrease. This means how much compensation should consumer received to make their utility level equal to the level before price increase. Some previous studies measuring the impact of price increase implement this measure for example Azzam and Rettab (2012), Wang and Çakır (2021), and Roosen, Staudigel and Rahbauer (2022). This measure is calculated using the difference of consumer expenditure function,

$$CV = m^1(\boldsymbol{p}^1, v^0) - m^0(\boldsymbol{p}^0, v^0) \tag{4.9}$$

where m denote consumer expenditure, $\boldsymbol{p}$ denote set of prices, v denote consumer utility level, and superscript 0 and 1 respectively denotes before and after price change.

5. Data and Empirical Model Specification

This section presents the data employed and the strategy used to derive elasticities measure to produce compensating variation (CV). The first part includes brief introduction to the data and how this data can be suitable for this study. The second part is explaining the estimation strategy.

5.1 Data Description

This section presents how can SUSENAS data can be used in this study. It includes data implementation in previous studies, data representation of Indonesian households, and summary statistics of selected variables. The section also discussed the classifications used in this study need to be adjusted because beef consuming households are only 5 percent. Therefore, new classification “Meat” is introduced that combine meat from chicken and beef.

5.1.1 Brief Introduction to SUSENAS Data

The data employed in this study is from the 2018 Indonesia National Socio-Economic Survey/*Survey Sosial Ekonomi Nasional* (SUSENAS) from Statistics Indonesia. The survey that builds this data is done each year starting from 1963. This survey covers household socio-economic condition including detailed food consumption data and other type of goods/services. The survey represents all Indonesian household; however, it does not track the same household each year, so the data collection method is a cross section in each survey year. Since the data offers detailed consumption data for various commodities, there are many previous studies that use this data to study Indonesian food consumption pattern, as far as this study found it starts from Boediono (1978).

Table 1 SUSENAS Data Implementation for Past Demand System Study

Author(s)	SUSENAS Year
Boediono (1978)	1976
Timmer and Alderman (1979)	1976
Teklu and Johnson (1987)	1980
Deaton (1990)	1981
Rachmat and Erwidodo (1993)	1990
Jensen and Manrique (1998)	1981, 1984, 1987
Saliem (2016)	1996
Faharuddin *et al.*, (2017)	2013
Faharuddin *et al.*, (2019)	2013

Author(s)	SUSENAS Year
Nikmatul *et al.*, (2020)	2016
This Study	2018

Source: Author's compilation

Since this survey is designed to represent all Indonesian households then the number of observed households is growing every year. The total number of households from 2018 survey used in this study consists of 295,155 households. This number of households represents 70,102,195 households. It covers all Indonesian region proportionally with most of the households are from Java-Bali region. The total number of households represented in 2018 is 42,389,184 households in Java-Bali region, 14,491,271 in Sumatera, and the rest of the regions have around 4 million households each.

Table 2 Number of Households Represented by SUSENAS

Region	Number of Represented Households
Sumatera	14,491,271
Java-Bali	42,389,184
Kalimantan	4,175,380
Sulawesi	4,739,465
Nusa Tenggara, Maluku, and Papua	4,306,895
Total	70,102,195

Source: Author's calculation

SUSENAS not only includes consumption data for detailed commodities, but also demographics data that is used in this study. The data for consumption includes quantity and value. It allows this study to measure unit value of each food commodity and estimate the price by adjusting the quality effect in unit value (discussed in Section 5.2.1). Since this study only focus on the Indonesia most strategic food commodities, then all other commodities are classified as processed food-beverages and other food items. The data also includes demographic variables used in this study. It includes household size, household urban/rural location, household head age, and household head education level.

5.1.2 Summary Statistics

The data has notable variation in demographic variables within regions. All the regions relatively have similar variation for each demographic variable. The mean value of household size and household head age and education level is only somewhat varied across regions but not significantly different considering their standard deviations (see Table 3). For example, the mean value for household size is around 4 across all regions with around 2 standard deviations. These numbers may picture a relatively similar household demographics across regions.

Table 3 Household Demographics Statistics by Region

Region	Size	Age	Education
Sumatera	3.97 (1.65)	46.91 (13.59)	1.78 (1.28)
Java-Bali	3.62 (1.56)	49.00 (14.03)	1.66 (1.30)
Kalimantan	3.87 (1.66)	45.95 (13.07)	1.71 (1.33)
Sulawesi	4.09 (1.89)	47.91 (14.07)	1.65 (1.38)
Nusmapua	4.08 (2.00)	45.48 (13.72)	1.52 (1.40)
Total	3.77 (1.65)	48.09 (13.92)	1.68 (1.31)

Notes: numbers in () are standard deviation, education level is rank variable with 0 without education level and 5 with post graduate degree.

Source: Author's calculation from 2018 SUSENAS

The main data to be analysed is household consumption data for Indonesia most strategic commodities. These commodities include rice, chicken meat, beef, chicken eggs, shallot, garlic, chili, fish, cooking oil, white sugar, and flour, while additional commodity groups are including in processed food-beverages and other food items (Table 4). There are relatively many households that have consumption data within each category, except for beef with only 5 percent of households that consume it. Therefore, the inclusion of disaggregated beef into demand system might cause the estimates to be not representative as it only represents small portion of Indonesian households. Even with special treatment to zero observation such as variable transformation as discussed in Bellemare and Wichman (2020) or other data generating process model, this huge portion of zero might still cause a problem that make the estimates to be unrepresentative for all Indonesian households. Thus, new classification "Meat" must be introduced that consist of meat from chicken and beef to avoid potential problem with the estimate.

Table 4 Number of Households with Non-Zero Consumption by Food Classifications

Classification	Non-Zero Obs. (Percentage)
Rice	287,629 (97.5)
Poultry	111,307 (37.7)
Beef	14,648 (5.0)
Chicken egg	232,674 (21.2)
Shallot	268,954 (91.1)
Garlic	254,782 (86.3)
Chili	254,821 (86.3)
Fish	261,872 (88.7)
Cooking oil	255,657 (86.6)
White sugar	269,281 (91.2)

Classification	Non-Zero Obs. (Percentage)
Flour	88,470 (30.0)
Processed food and beverages	292,362 (99.1)
Other food items	293,546 (99.5)

Source: Author's calculation from 2018 SUSENAS

The mean value of weekly household consumption data varies across regions, but they are not significantly different from each other as the variation is relatively high for all food classifications. A relatively huge difference in mean values is found for chili and garlic. Chili consumption value for Sumatera region is around two times higher than any other regions, while garlic consumption value for Sulawesi is around half of other regions. These differences may reflect a variation in consumer taste because Sumatera is one of the main chili producers in Indonesia, while garlic is mainly imported, so the price is expected to be lower in Sumatera for chili and relatively similar across Indonesia for garlic. Lastly, the mean of total weekly food consumption is IDR 549,727 in Kalimantan and IDR 459,088 in Sulawesi with standard deviation around IDR 300,000.

Table 5 Average Weekly Household Consumption Value by Food Classification and Region

Classification	Sumatera	Java-Bali	Kalimantan	Sulawesi	Nusmapua
Rice	65,810 (34,417)	51,942 (27,121)	61,334 (32,816)	61,150 (33,553)	74,261 (43,786)
Meat	30,989 (25,516)	30,108 (28,428)	37,077 (28,545)	45,218 (28,636)	40,050 (33,926)
Chicken egg	13,556 (8,849)	12,338 (8,568)	15,768 (10,451)	11,864 (9,347)	13,773 (10,339)
Shallot	6,379 (3,532)	4,644 (3,081)	5,599 (3,350)	4,491 (3,213)	6,388 (4,344)
Garlic	3,953 (2,711)	4,084 (2,856)	4,608 (3,105)	2,851 (2,327)	5,357 (3,935)
Chili	16,841 (11,102)	8,086 (6,930)	8,280 (7,157)	7,182 (6,689)	8,400 (7,374)
Fish	55,800 (43,843)	33,696 (34,266)	65,084 (46,665)	56,657 (41,138)	54,538 (48,453)
Cooking oil	12,379 (6,262)	10,013 (5,756)	11,993 (6,143)	10,032 (6,119)	12,279 (7,630)
White sugar	8,944 (5,544)	5,903 (4,111)	9,728 (5,914)	8,125 (4,939)	9,763 (6,281)
Flour	5,278 (3,432)	3,652 (2,681)	5,604 (3,623)	5,554 (3,484)	7,554 (4,743)
Processed food and bev.	153,731 (131,636)	185,617 (153,278)	185,252 (155,411)	146,057 (144,172)	122,985 (127,943)

Classification	Sumatera	Java-Bali	Kalimantan	Sulawesi	Nusmapua
Other food items	167,686 (118,147)	152,294 (115,493)	171,232 (125,979)	151,930 (122,832)	174,779 (137,930)
Total	511,643 (277,932)	472,797 (293,968)	549,727 (300,827)	459,088 (293,178)	472,620 (292,524)

Notes: numbers in () are standard deviation and all values in Indonesian Rupiah (IDR) with SEK 1 is around IDR 1,500

Source: Author's calculation from 2018 SUSENAS

5.2 Empirical Model Specification

This study fit a QUAIDS for each of five regions of Indonesia for evaluating the heterogeneity. The regions are Sumatera, Java-Bali, Kalimantan, Sulawesi, and Nusmapua. The empirical strategies before estimating each demand system are discussed in this section including price quality adjustment, two-stage demand system, and restrictions of demand system.

5.2.1 Price Quality Adjustment and Missing Unit Value Treatment

This study implements a strategy to adjust the unit value into a more representing price variation measure. It was previously used by Faharuddin *et al.*, (2019) and earlier it was developed and used in Cox and Wohlgenant (1986) and Goldman and Grossman (1978). The strategy is needed because there might be variation in unit value measurement caused by consumer preference on quality. Therefore, to get a better measure of price, the quality effect must be separated. To do that the unit value measure is regressed with household demographic variables,

$$(5.1) \qquad \ln v_i = \alpha_i + \textstyle\sum_j \gamma_{ij}\, b_{ij} + \varepsilon_i$$

where v_i is a unit value, α_i is constant, b_{ij} is a set of explanatory variables including household expenditure and demographics, γ_{ij} is a set of unknown parameters, ε_i is the error term, i denoting commodity classification. The adjusted price at community level then calculated as

$$(5.2) \qquad p_i = \overline{\exp(\alpha_\iota + \varepsilon_\iota)}$$

The result from this strategy is the same price for all household in the same community level, thus it also acts as a treatment for households with missing unit value. This study also uses the mean of adjusted price at higher regional level for the community with missing value.

5.2.2 Two-Stages Demand System

Since developing full demand systems requires a lot of parameters to be estimated, a multi-stage budgeting procedure should be implemented. The implementation of multi-stage budgeting procedure is common in previous studies using demand system. This study also implements multi-stage budgeting procedure by first estimate the demand system for food and non-food classifications. In the second step the demand system for most strategic food classifications is estimated. The budgeting procedure is illustrated in Figure 1 below.

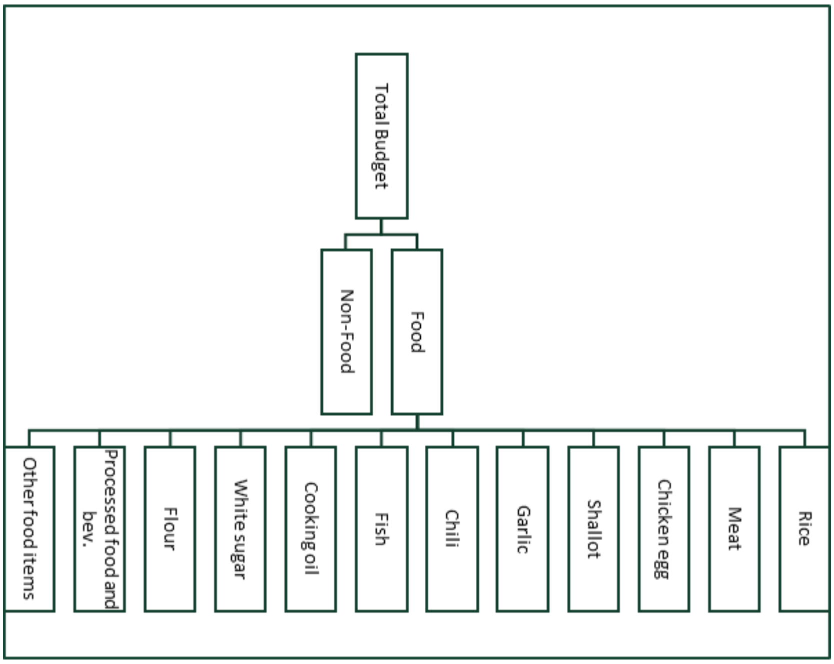

Figure 1 Two-Stages Budgeting Procedure

Two steps estimation strategy is implemented for calculating unconditional elasticities of each food classifications. The first step is calculating aggregate food expenditure elasticities and the second step is calculating the conditional elasticities for each food classification. This strategy is following a tradition in demand system studies such as Säll and Gren (2015), Widarjono and Rucbha (2016), and Roosen, Staudigel and Rahbauer (2022). The unconditional elasticities are then calculated using Edgerton's (1997) two stage demand system method from the calculated elasticities by equation (4.6) – (4.8). Therefore, the unconditional budget elasticities for each food classification is defined as follow.

$$(5.3) \qquad e_i^* = e_{(r)i} e_r$$

while unconditional uncompensated and compensated price elasticities respectively are,

$$(5.4) \qquad e_{ij}^{u*} = e_{(r)ij}^{u} + e_{(r)i}\left(w_{(r)j} + e_{r=s}^{u} w_{(r)j}\right)$$

$$(5.5) \qquad e_{ij}^{c*} = e_{(r)ij}^{c} + e_{(r)i} w_{(r)j} e_{r=s}^{c}$$

Since all unconditional elasticities that need to be estimated are from food groups then e_i^* is the unconditional expenditure elasticity for i-th food classification, $e_{(r)i}$ is conditional expenditure elasticity within food demand system (r) for each i-th food classification, e_r is expenditure elasticity for food from the first step, e_{ij}^{u*} is unconditional uncompensated price elasticities for i-th and j-th pair of food classifications, $e_{(r)ij}^{u}$ is conditional uncompensated price elasticities within food demand system (r) for each i-th and j-th pair of food classifications, $w_{(r)j}$ is the share of j-th food expenditure within food demand system (r), $e_{r=s}^{u}$ is food own price elasticity from the first step, and upper notation (c) is used to denotes compensated elasticity.

The estimation strategy for both steps are done using the quadratic AIDS package in Stata developed by Lecocq and Robin (2015). The program used in this study is different than previous studies in Indonesia such as Faharuddin et al., (2017, 2019) and Nikmatul et al., (2020) as they use the Stata program developed by Poi (2012). Here the program has an advantage compared to Poi's program because it can fit the AIDS model faster with less computational needs. The program can also produce similar elasticities with the same data and specification as Poi's program. More than that, the program allows the user to use observation weight which is an important feature of the survey data used in this study. However, the demographic variables and regional fixed effect can enter the model only through the intercept, so it is not allowed to enter all terms in the model, therefore this study must fit the AIDS by each region to allow the regional heterogeneity to enter to all terms.

5.2.3 Restrictions

The basic assumptions of the demand system that make it compatible with consumer theory are adding-up, homogeneity, and symmetry. The first assumption is made up from the data while the last two equation can be restricted. The program proposed by Lecocq and Robin (2015) allow these last two assumptions to be restricted from the model, therefore it can adjust the estimates to satisfy consumer theory. However, these restrictions are very strong and sometimes not attainable because each individual equation within demand system can produced a number of coefficients that far from the restricted value. It is noted by Deaton and Muellbauer (1980) that the failure of these assumptions is often observed. Therefore, this study choose the unrestricted estimates.

5.3 Welfare Impact of Price Changes

This section presents the empirical method of measuring welfare impact and the determination of price increase events.

5.3.1 Measurement

There is a method to estimate the welfare impact of price increase by only using available information from demand system estimation. This method was implemented by Azzam and Rettab (2012) to measure the welfare impact of price increase of United Arab Emirates (UAE) agricultural products. Most recently it has also been implement within food policy discussion, see Roosen, Staudigel and Rahbauer (2022) and Wang and Çakır (2021). This method exploits the information from consumer theory which states that Marshallian demand intersects with Hicksian demand at initial condition, so it allows the change in Hicksian demand to be estimated without information on the utility levels. This information is useful since the direct measurement of CV using equation (4.9) is not possible because utility level is unobservable.

Using this information, equation (4.9) can be transformed into,

$$CV = [p_1^1 q_1^c(\boldsymbol{p}^1, v^0) - p_1^0 q_1^0] + [p_2^1 q_2^c(\boldsymbol{p}^1, v^0) - p_2^0 q_2^0] + \cdots + [p_{12}^1 q_{12}^c(\boldsymbol{p}^1, v^0) - p_{12}^0 q_{12}^0] \tag{5.6}$$

and since,

$$dp_i = p_i^1 - p_i^0 \text{ for } i = 1, 2, \ldots, 12 \tag{5.7}$$

$$dq_i^c = q_i^c - q_i^0 \text{ for } i = 1, 2, \ldots, 12 \tag{5.8}$$

then CV is allowed to be approximated using,

$$CV = \sum_i^{12} p_i^0 q_i^0 \left(\frac{dp_i}{p_i^0} + \frac{dq_i^c}{q_i^0} + \frac{dp_i}{p_i^0} \frac{dq_i^c}{q_i^0} \right) \tag{5.9}$$

the change in Hicksian or compensated demand then approximated using,

$$\frac{dq_i^c}{q_i^0} \approx \sum_{j=1}^{12} e_{i,j}^{c*} \frac{dp_j}{p_j^0} \text{ for } i = 1, 2, \ldots, 12 \tag{5.10}$$

where $e_{i,j}^{c*}$ is unconditional compensated price elasticity.

5.3.2 Price Increase Events

This study gathers observed price data for each region. The observed provincial weekly price data from 2018 until March 2022 is gathered from *Pusat Informasi*

Harga Pangan Strategis Nasional (PIHPS) or National Strategic Food Price Information Centre that is free to download from their website (www.hargapangan.id). The regional data is then constructed by using the unweighted average of provincial data within each region. After that, the percentage deviation from previous period average is calculated at two selected points.

The points are selected based on recent food price events in the Indonesian market. The most recent event is the increase of cooking oil prices in early 2022, thus the selected point is the fifth week of January 2022. The other event is the Eid al-Fitr celebration when prices are usually higher, thus the fourth week of May 2019 is selected. The percentage deviation from previous period average at these two events are presented in Table 6 below.

Table 6 Recent Price Hikes Events of Indonesian Most Strategic Food Commodities

Classification	Sumatera	Java-Bali	Kalimantan	Sulawesi	Nusmapua
		January 2022, Week 5			
Rice	-0.5%	0.8%	0.9%	-0.2%	0.0%
Meat*	2.8%	3.8%	14.9%	5.3%	5.5%
Chicken egg	2.8%	-12.0%	0.2%	5.2%	4.7%
Shallot	-4.7%	-6.5%	-6.8%	-1.6%	-4.3%
Garlic	-0.3%	-5.5%	0.1%	-2.0%	-3.8%
Chili**	-22.7%	-17.2%	13.4%	2.9%	11.9%
Fish	0.0%	0.0%	0.0%	0.0%	0.0%
Cooking oil	37.5%	40.3%	36.5%	35.1%	36.0%
White sugar	4.1%	3.5%	6.5%	2.3%	1.8%
Flour	0.0%	0.0%	0.0%	0.0%	0.0%
Process food.	0.0%	0.0%	0.0%	0.0%	0.0%
Other food.	0.0%	0.0%	0.0%	0.0%	0.0%
		May 2019, Week 4			
Rice	-1.2%	-2.6%	1.5%	-1.0%	-1.1%
Meat*	1.7%	2.6%	3.0%	2.7%	-4.7%
Chicken egg	1.0%	0.4%	4.7%	11.6%	5.8%
Shallot	16.4%	13.7%	17.7%	19.2%	22.2%
Garlic	36.2%	28.3%	38.7%	48.3%	50.6%
Chili**	19.8%	15.2%	14.6%	7.6%	8.3%
Fish	0.0%	0.0%	0.0%	0.0%	0.0%
Cooking oil	-3.4%	-2.8%	-2.0%	-0.1%	-2.1%
White sugar	2.6%	4.4%	4.4%	-0.8%	-1.3%
Flour	0.0%	0.0%	0.0%	0.0%	0.0%
Process food.	0.0%	0.0%	0.0%	0.0%	0.0%

Classification	Sumatera	Java-Bali	Kalimantan	Sulawesi	Nusmapua
Other food.	0.0%	0.0%	0.0%	0.0%	0.0%

Notes: *chicken meat observed price is used for meat; **red chili observed price is used for chili; percentage is compared with previous period average price; fish, flour, processed food, and other food prices are assumed to be constant since there is no observed data.

Source: Author's calculation

The first scenario is based on recent cooking oil price increase in January 2022. This event is unexpected because cooking oil prices are usually stable as production capacity is huge in Indonesia. There are some social stress incidences following this event because many Indonesian household competing for cheaper oil that is hard to find in the market during this time. The cooking oil price increases by 37 percent on average at January 2022 week 5, the highest was in Java-Bali with 40.3 percent increase from previous average price. Fortunately, other important commodities' prices didn't increase as well, so it can dampen the negative welfare impact.

The second scenario is an important event for most Indonesian households when people usually gather with families and friends to celebrate Eid after fasting during the month of Ramadhan. Employer legally should give holiday allowance to their worker and prices usually goes up during this period because of demand shock. One important message from central government during this period is about dampening the shock by making sure the availability of commodities, safe distribution line, consumer affordability, and effective communication between institutions. The last normal celebration before Covid-19 restrictions was in 2019 when the prices of some commodities are found to be immensely higher.

6. Results and Discussion

This section presents the results from this study and provide each with the discussion. The section is divided into three parts: 1) estimation results, 2) elasticities, and 3) welfare impact.

6.1 Estimation Results

The estimation results for price quality adjustment suggest that unit value measurement need to be adjusted before using it as price in demand system analysis. This is because some variables are found to affect the unit value, so that adjusted unit values are found to be less varied than unadjusted one. Therefore, this study made an adjustment to the unit value before using it in demand system estimation following equation 5.1 - 5.2. More discussion on the adjustment process can be found in Appendix 2.

The demand system coefficients reported in this study is only limited to real expenditure, own-price, and demographic variables coefficients since there are too many coefficients within the demand system. Meanwhile all the coefficients value will be reflected in the estimated elasticities presented in the next section. Therefore, the following section present the coefficients for real expenditure, own-price, household size, household head age, and college level education. However, the rest of the coefficients can be found in the Appendix 3.

6.1.1 Real Expenditure Coefficients

The coefficients for real expenditure and its quadratic term are reported in Table 7 and Table 8. The relationship direction for both is varied between classifications and some also varied across regions. This variation reflects how consumption pattern differ across food classifications and regions for example rice have negative real expenditure coefficient in all regions, while fish have positive real expenditure coefficient in most regions. Meanwhile, not all regions have similar pattern, for example, while the other regions show a positive coefficient, the coefficient for fish in Sulawesi is significantly negative. There is also different consumption pattern across regions in egg, cooking oil, and white sugar.

Table 7 Estimates for β (Coefficient for Real Expenditure)

Equation	Indonesia	Sumatera	Java-Bali	Kalimantan	Sulawesi	Nusmapua
foodshare	-0.203*	-0.224*	-0.201*	-0.239*	-0.222*	-0.168*
	(0.002)	(0.004)	(0.003)	(0.006)	(0.005)	(0.006)
non-foodshare	0.203*	0.224*	0.201*	0.239*	0.222*	0.168*
	(0.002)	(0.004)	(0.003)	(0.006)	(0.005)	(0.006)
w1 (rice)	-0.068*	-0.087*	-0.065*	-0.073*	-0.061*	-0.111*
	(0.005)	(0.010)	(0.007)	(0.011)	(0.022)	(0.027)
w2 (meat)	0.036*	0.044*	0.033*	0.041*	0.01	0.032
	(0.004)	(0.008)	(0.006)	(0.012)	(0.025)	(0.024)
w3 (egg)	-0.002	-0.009‡	-0.002	0.003	0.001	0.02†
	(0.002)	(0.004)	(0.003)	(0.005)	(0.009)	(0.010)
w4 (shallot)	0.006*	-0.002	0.006*	0.006*	0.003	0.004
	(0.001)	(0.002)	(0.001)	(0.002)	(0.003)	(0.003)
w5 (garlic)	0.008*	0.001	0.009*	0.005*	0.003	0.003
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.003)
w6 (chili)	0.004†	-0.007	0.003	0.006	0.01†	-0.005
	(0.003)	(0.004)	(0.002)	(0.004)	(0.006)	(0.007)
w7 (fish)	0.016*	0.042*	0.013†	0.036†	-0.057†	0.002
	(0.016)	(0.012)	(0.007)	(0.19)	(0.034)	(0.031)
w8 (cooking oil)	0.002	-0.009*	0.002	0.008‡	-0.007	-0.008
	(0.001)	(0.003)	(0.002)	(0.003)	(0.006)	(0.006)
w9 (white sugar)	0.006*	-0.012*	0.01*	0.007‡	0.006	0.001
	(0.006)	(0.002)	(0.001)	(0.003)	(0.005)	(0.005)
w10 (flour)	0.003*	-0.001	0.002†	0.007*	0.018*	0.008†
	(0.001)	(0.002)	(0.001)	(0.002)	(0.005)	(0.004)
w11 (processed food)	0.014	0.08*	-0.006	0.034	0.091	-0.022
	(0.013)	(0.024)	(0.021)	(0.038)	(0.068)	(0.068)
w12 (other food)	-0.02	-0.042‡	-0.005	-0.076‡	-0.016	0.077
	(0.012)	(0.021)	(0.017)	(0.037)	(0.060)	(0.057)

Notes: standard error in parentheses, * $p<0.1$, ‡ $p<0.05$, † $p<0.01$

Source: Author's calculation

The coefficients of the quadratic term are mostly significantly different from zero, however in most cases they have a similar direction as real expenditure coefficient. Both findings confirms that it is important to have the quadratic term in the demand system, since they mostly have significant role within the equations. The only exception is for cooking oil in Sumatera which have a negative real expenditure coefficient and positive quadratic real expenditure, while the other is either not significantly different from zero in one of the real expenditure coefficients or both. Therefore, the quadratic term can only strengthen the relationship of level term and not change the relationship direction.

Table 8 Estimates for λ (Coefficient for Quadratic Real Expenditure)

Equation	Indonesia	Sumatera	Java-Bali	Kalimantan	Sulawesi	Nusmapua
foodshare	-0.013*	-0.018*	-0.012*	-0.023*	-0.021*	-0.011*
	(0.000)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)

Equation	Indonesia	Sumatera	Java-Bali	Kalimantan	Sulawesi	Nusmapua
nfoodshare	0.013* (0.000)	0.018* (0.001)	0.012* (0.000)	0.023* (0.001)	0.021* (0.001)	0.011* (0.001)
w1 (rice)	0.000 (0.000)	-0.003‡ (0.001)	0.001 (0.001)	-0.002 (0.001)	0.001 (0.002)	-0.005 (0.003)
w2 (meat)	0.004* (0.000)	0.005* (0.001)	0.004* (0.001)	0.007* (0.001)	0.003 (0.002)	0.005† (0.003)
w3 (egg)	0.001* (0.000)	0.001 (0.000)	0.001* (0.000)	0.002* (0.001)	0.001 (0.001)	0.003‡ (0.001)
w4 (shallot)	0.001* (0.000)	0.001* (0.000)	0.001* (0.000)	0.002* (0.000)	0.001‡ (0.000)	0.001‡ (0.000)
w5 (garlic)	0.001* (0.000)	0.001* (0.000)	0.002* (0.000)	0.002* (0.000)	0.001‡ (0.000)	0.001‡ (0.000)
w6 (chili)	0.001* (0.000)	0.001 (0.000)	0.001* (0.000)	0.002‡ (0.000)	0.002‡ (0.000)	-0.001 (0.001)
w7 (fish)	0.001‡ (0.001)	0.004* (0.001)	0.001† (0.001)	0.004 (0.002)	-0.004 (0.003)	0.001 (0.003)
w8 (cooking oil)	0.001* (0.000)	0.001† (0.000)	0.002* (0.000)	0.003* (0.000)	0.001 (0.000)	0.001 (0.001)
w9 (white sugar)	0.001* (0.000)	-0.001 (0.000)	0.002* (0.000)	0.002* (0.000)	0.001‡ (0.000)	0.001† (0.001)
w10 (flour)	0.001* (0.000)	0.001* (0.000)	0.001* (0.000)	0.002* (0.000)	0.002* (0.000)	0.002* (0.000)
w11 (processed food)	-0.005* (0.001)	0.004† (0.002)	-0.008* (0.001)	-0.003 (0.005)	0.002 (0.005)	-0.006 (0.007)
w12 (other food)	-0.008* (0.001)	-0.013* (0.002)	-0.006* (0.002)	-0.017* (0.004)	-0.008 (0.005)	-0.003 (0.006)

Notes: standard error in parentheses, * p<0.1, ‡ p<0.05, † p<0.01

Source: Author's calculation

6.1.2 Own-Price Coefficient

The coefficients for own price reported in Table 9 are mostly positive and have less variation unlike the real expenditure coefficients. The exceptions are the coefficient for foodshare in Java-Bali, garlic in Sulawesi, and white sugar in Kalimantan which have negative coefficient. The mostly positive own-price coefficients are also reported in Deaton and Muellbauer (1980) with only exception in transport and communication classification.

Table 9 Estimates for γ_{ij} for $i = j$ (Coefficient for Own Price)

Equation	Indonesia	Sumatera	Java-Bali	Kalimantan	Sulawesi	Nusmapua
foodshare	0.01* (0.002)	0.044* (0.006)	-0.016* (0.004)	0.08* (0.010)	0.116* (0.007)	0.057* (0.006)
non-foodshare	0.135* (0.002)	0.154* (0.006)	0.126* (0.004)	0.185* (0.010)	0.179* (0.007)	0.129* (0.006)
w1 (rice)	0.076* (0.003)	0.092* (0.007)	0.075* (0.004)	0.045* (0.007)	0.053* (0.012)	0.175* (0.021)
w2 (meat)	0.037* (0.001)	0.040* (0.002)	0.036* (0.002)	0.027* (0.003)	0.022* (0.003)	0.040* (0.006)

Equation	Indonesia	Sumatera	Java-Bali	Kalimantan	Sulawesi	Nusmapua
w3 (egg)	0.008* (0.001)	0.004* (0.002)	0.009* (0.001)	0.005‡ (0.002)	0.002 (0.003)	0.006 (0.005)
w4 (shallot)	0.003* (0.000)	0.004* (0.000)	0.003* (0.000)	0.005* (0.001)	0.002‡ (0.000)	0.001 (0.001)
w5 (garlic)	0.003* (0.000)	0.004* (0.000)	0.003* (0.000)	0.003* (0.001)	-0.001‡ (0.000)	-0.001 (0.001)
w6 (chili)	0.007* (0.000)	0.008* (0.001)	0.007* (0.000)	0.004* (0.001)	0.002 (0.001)	0.004‡ (0.001)
w7 (fish)	0.03* (0.001)	0.055* (0.004)	0.028* (0.001)	0.05* (0.006)	0.038* (0.012)	0.042* (0.006)
w8 (cooking oil)	0.012* (0.001)	0.014* (0.001)	0.011* (0.001)	0.012* (0.002)	0.006‡ (0.002)	0.015* (0.003)
w9 (white sugar)	0.001* (0.000)	0.001 (0.000)	0.001* (0.000)	-0.002‡ (0.001)	0.002 (0.001)	0.005‡ (0.002)
w10 (flour)	0.003* (0.000)	0.002* (0.000)	0.002* (0.000)	0.004* (0.001)	0.007* (0.001)	0.004‡ (0.001)
w11 (processed food)	0.074* (0.004)	0.093* (0.012)	0.062* (0.005)	0.149* (0.012)	0.111* (0.036)	0.104* (0.018)
w12 (other food)	0.043* (0.003)	0.077* (0.007)	0.039* (0.003)	0.021 (0.016)	0.063* (0.014)	0.148* (0.026)

Notes: standard error in parentheses, * p<0.1, ‡ p<0.05, † p<0.01

Source: Author's calculation

6.1.3 Household Size

Household size play an important role in explaining household food consumption. The relationship direction is varied between food classifications but not any inversely different direction found across regions. Bigger household tend to spend higher portion of their expenditure on rice, egg, processed food, cooking oil, white sugar, and flour, while less on other classifications such as meat and fish.

Table 10 Coefficient for α_i (Coefficient for Household Size)

Equation	Indonesia	Sumatera	Java-Bali	Kalimantan	Sulawesi	Nusmapua
foodshare	0.034* (0.000)	0.028* (0.000)	0.04* (0.000)	0.027* (0.000)	0.022* (0.000)	0.029* (0.000)
nfoodshare	-0.034* (0.000)	-0.028* (0.000)	-0.04* (0.000)	-0.027* (0.000)	-0.022* (0.000)	-0.029* (0.000)
w1 (rice)	0.013* (0.000)	0.012* (0.000)	0.013* (0.000)	0.011* (0.000)	0.011* (0.001)	0.014* (0.001)
w2 (meat)	-0.002* (0.000)	-0.002* (0.000)	-0.002* (0.000)	-0.002* (0.000)	-0.002† (0.001)	-0.004* (0.001)
w3 (egg)	0.001* (0.000)	0.001* (0.000)	0.002* (0.000)	0.002* (0.000)	0.001 (0.000)	-0.001 (0.000)
w4 (shallot)	-0.001* (0.000)	-0.001 (0.000)	-0.001* (0.000)	-0.001 (0.000)	-0.001‡ (0.000)	-0.001‡ (0.000)
w5 (garlic)	-0.001‡ (0.000)	-0.001* (0.000)	-0.001 (0.000)	0.001 (0.000)	-0.001† (0.000)	-0.001† (0.000)

Equation	Indonesia	Sumatera	Java-Bali	Kalimantan	Sulawesi	Nusmapua
w6 (chili)	-0.001* (0.000)	-0.001* (0.000)	-0.001* (0.000)	-0.001‡ (0.000)	0.001 (0.000)	-0.001‡ (0.000)
w7 (fish)	-0.005* (0.000)	-0.006* (0.000)	-0.004* (0.000)	-0.007* (0.001)	-0.004* (0.001)	-0.001 (0.001)
w8 (cooking oil)	0.001* (0.000)	0.001* (0.000)	0.001* (0.000)	0.001* (0.000)	0.001 (0.000)	0.001† (0.000)
w9 (white sugar)	0.001* (0.000)	0.002* (0.000)	0.001* (0.000)	0.001* (0.000)	0.001 (0.000)	0.001 (0.000)
w10 (flour)	0.001* (0.000)	0.001* (0.000)	0.001* (0.000)	0.001* (0.000)	0.001 (0.000)	0.001 (0.000)
w11 (processed food)	0.005* (0.001)	0.008* (0.001)	0.005* (0.001)	0.006* (0.001)	0.007* (0.002)	0.005‡ (0.002)
w12 (other food)	-0.013* (0.001)	-0.015* (0.001)	-0.013* (0.001)	-0.012* (0.001)	-0.013* (0.002)	-0.014* (0.002)

Notes: standard error in parentheses, * p<0.1, ‡ p<0.05, † p<0.01

Source: Author's calculation

6.1.4 Household Head Age

Household head age play an important role in explaining household food consumption. Most coefficients reported in Table 11 are significantly different from zero, while the relationship direction is negative for aggregated food and positive for non-food. Meanwhile, most of detailed food classifications have positive coefficient except for egg, processed food, and other food. This means that older household head tend to consume fresh food instead of processed one and in Kalimantan they significantly consumed less egg.

Table 11 Coefficient for α_i (Coefficient for Household Head Age)

Equation	Indonesia	Sumatera	Java-Bali	Kalimantan	Sulawesi	Nusmapua
foodshare	-0.0007* (0.000)	-0.00042* (0.000)	-0.00087* (0.000)	-0.00063* (0.000)	-0.0008* (0.000)	-0.0005* (0.000)
nfoodshare	0.0007* (0.000)	0.00042* (0.000)	0.00087* (0.000)	0.00063* (0.000)	0.0008* (0.000)	0.0005* (0.000)
w1 (rice)	0.00023* (0.000)	0.00024* (0.000)	0.00023* (0.000)	0.0003* (0.000)	0.00024* (0.000)	0.00038* (0.000)
w2 (meat)	0.00023* (0.000)	0.00016* (0.000)	0.00026* (0.000)	0.00003 (0.000)	0.00027* (0.000)	0.00032* (0.000)
w3 (egg)	0.00001 (0.000)	0.00002 (0.000)	0.00001 (0.000)	-0.00006* (0.000)	-0.00002 (0.000)	-0.00001 (0.000)
w4 (shallot)	0.00002* (0.000)	0.00002* (0.000)	0.00002* (0.000)	0.00001 (0.000)	-0.00001 (0.000)	0.00001 (0.000)
w5 (garlic)	0.00002* (0.000)	0.00002‡ (0.000)	0.00002* (0.000)	0.00001 (0.000)	0.00001 (0.000)	0.00002 (0.000)
w6 (chili)	0.00004* (0.000)	0.0001* (0.000)	0.00004* (0.000)	-0.00002 (0.000)	-0.00003 (0.000)	0.00002 (0.000)
w7 (fish)	0.00032* (0.000)	0.0005* (0.000)	0.00024* (0.000)	0.00074* (0.000)	0.00051* (0.000)	0.00035‡ (0.000)

Equation	Indonesia	Sumatera	Java-Bali	Kalimantan	Sulawesi	Nusmapua
w8 (cooking oil)	0.00004* (0.000)	0.00003* (0.000)	0.00004* (0.000)	0.00005* (0.000)	0.00004 (0.000)	0.00005 (0.000)
w9 (white sugar)	0.00005* (0.000)	0.00007* (0.000)	0.00005* (0.000)	0.00009* (0.000)	0.00006* (0.000)	0.00012* (0.000)
w10 (flour)	0.00001* (0.000)	0.00002* (0.000)	0.00001* (0.000)	0.00001 (0.000)	-0.00001 (0.000)	0.00008* (0.000)
w11 (processed food)	-0.00057* (0.000)	-0.00055* (0.000)	-0.00058* (0.000)	-0.00023 (0.000)	-0.0007* (0.000)	-0.00082* (0.000)
w12 (other food)	-0.00038* (0.000)	-0.0006* (0.000)	-0.00031* (0.000)	-0.00091* (0.000)	-0.00037 (0.000)	-0.00049† (0.000)
Notes: standard error in parentheses, * $p<0.1$, ‡ $p<0.05$, † $p<0.01$						

Source: Author's calculation

6.1.5 College Level Household Head Education

The role of education is found to be significant in explaining household consumption as there are many significantly different from zero coefficients reported in Table 12. This table show that household with college level education consume less food and more non-food for all regions. Meanwhile, they consume more in meat, fish, and processed food with less in rice, sugar, and other food. This pattern might come from the consideration from household to achieve better health outcome by consume more source of protein and avoiding some food including tobacco in other food classification.

Table 12 Coefficient for α_i (Coefficient for Household Head with College Level Education)

Equation	Indonesia	Sumatera	Java-Bali	Kalimantan	Sulawesi	Nusmapua
foodshare	-0.086* (0.001)	-0.082* (0.002)	-0.09* (0.002)	-0.075* (0.003)	-0.087* (0.003)	-0.084* (0.002)
nfoodshare	0.086* (0.001)	0.082* (0.002)	0.09* (0.002)	0.075* (0.003)	0.087* (0.003)	0.084* (0.002)
w1 (rice)	-0.008* (0.001)	-0.008* (0.002)	-0.007* (0.001)	-0.008* (0.002)	0.005 (0.003)	-0.01‡ (0.005)
w2 (meat)	0.015* (0.001)	0.013* (0.001)	0.016* (0.001)	0.011* (0.002)	0.01* (0.004)	0.018* (0.004)
w3 (egg)	0.002* (0.000)	0.002‡ (0.001)	0.002* (0.000)	-0.001 (0.001)	-0.001 (0.001)	0.003 (0.002)
w4 (shallot)	-0.001‡ (0.000)	-0.001 (0.000)	-0.001‡ (0.000)	-0.001‡ (0.000)	0.001 (0.000)	-0.001 (0.001)
w5 (garlic)	0.001‡ (0.000)	-0.001 (0.000)	0.001‡ (0.000)	-0.001‡ (0.000)	0.001 (0.000)	-0.001 (0.001)
w6 (chili)	-0.001 (0.000)	0.001 (0.001)	-0.001† (0.000)	-0.001 (0.001)	-0.002‡ (0.001)	-0.002 (0.001)
w7 (fish)	0.013* (0.001)	0.021* (0.002)	0.01* (0.001)	0.014* (0.004)	0.024* (0.005)	0.01 (0.006)
w8 (cooking oil)	0.001 (0.000)	0.001 (0.000)	0.001 (0.000)	0.001 (0.001)	-0.001 (0.001)	0.001 (0.001)

Equation	Indonesia	Sumatera	Java-Bali	Kalimantan	Sulawesi	Nusmapua
w9 (white sugar)	-0.002* (0.000)	-0.004* (0.000)	-0.001* (0.000)	-0.003* (0.001)	-0.003* (0.001)	-0.003* (0.001)
w10 (flour)	-0.001 (0.000)	0.001 (0.000)	-0.001 (0.000)	0.001 (0.000)	-0.001 (0.001)	-0.001 (0.001)
w11 (processed food)	0.024* (0.002)	0.014* (0.004)	0.026* (0.003)	0.03* (0.007)	0.009 (0.011)	0.012 (0.012)
w12 (other food)	-0.044* (0.002)	-0.039* (0.004)	-0.045* (0.003)	-0.043* (0.007)	-0.041* (0.011)	-0.027‡ (0.011)

Notes: standard error in parentheses, * p<0.1, ‡ p<0.05, † p<0.01

Source: Author's calculation

6.2 Engel Curve and Estimated Elasticities

The consumption pattern from the elasticity's estimates related to stated hypotheses is discussed in this section. The estimated Engel's curve shows that overall consumption pattern for food expenditure share is lower when larger expenditure observed, while the pattern for non-food expenditure share is the opposite. The most strategic food consumption pattern variation is observed both among food classifications and among regions. Therefore, supporting this study hypotheses.

Moreover, cross price elasticity is found to be varied between regions even only considering respond to rice price change. This variety is about how other commodities are categorized as complements or substitutes in each regional setting. Some explanation can obvious such as consumer respond higher rice price by consuming more processed food such as noodle to compensate carbohydrate need. However, some findings need additional explanation such as consumer respond higher rice price by consuming more chili or egg. The explanation for this is that higher rice price can shift consumer expenditure towards other carbohydrate that may need more chili or egg in the ingredients, however it is beyond the scope of this study to explains the detail mechanism. This section report and discuss Engel curve followed by four elasticities number: 1) expenditure elasticity, 2) Marshallian/uncompensated own price elasticity, 3) Hicksian/compensated own price elasticity, and 4) cross-price elasticity.

6.2.1 Estimated Engel Curve

The estimated Engel curve for aggregated food and non-food classifications show an expected pattern but no U-shaped relationship observed in this study. The food consumption share is decreasing with expenditure, and it decreases more faster in higher expenditure, while the opposite is applied for non-food classification. There are observed regional variation in the pattern, however they all move in the same direction.

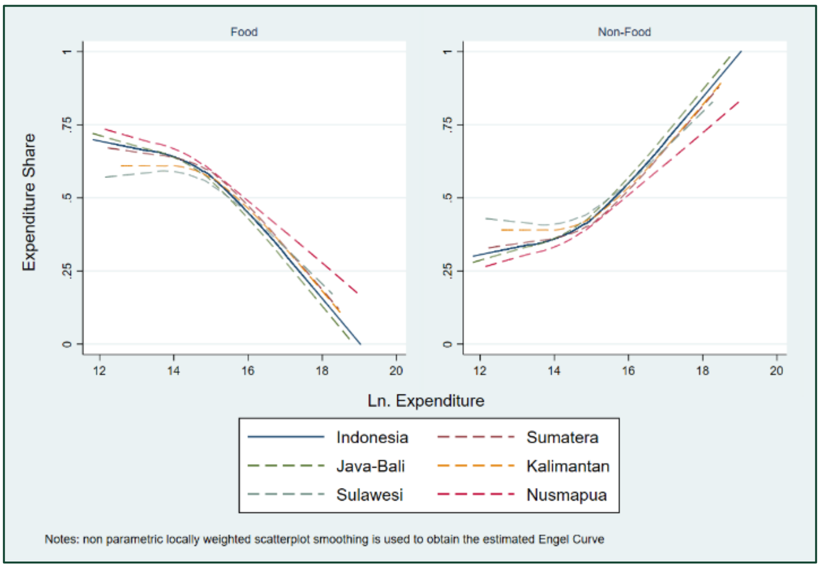

Figure 2 Estimated Engel Curve for Aggregated Food and Non-Food Classifications

The same pattern is observed within detailed food classifications as they mostly decrease as expenditure get higher, however there are some exceptions both in direction and regional pattern variation. These exceptions are fish, processed food, and other food items where each does not have similar negative relationship as other food classifications. The share of processed food and other food items are increasing with expenditure, while other food items tend to stop increase at some expenditure level. The shape of Engel curve for fish is varied across regions with Sulawesi have negative slope and other regions have U- or inverted U- relationship at some observed expenditure level. Other regional variation is also observed in other classification for example meat curve for Sulawesi and Egg curve for Nusmapua.

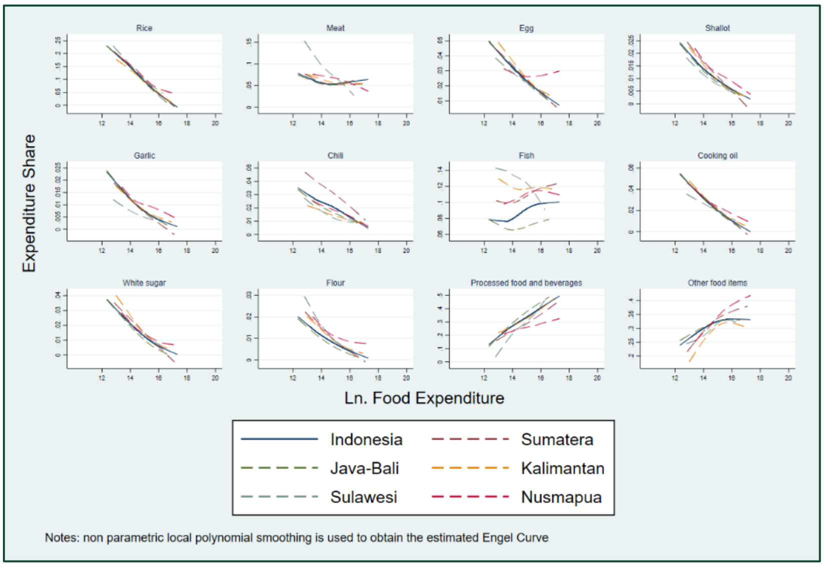

Figure 3 Estimated Engel Curve for Food Classifications

6.2.2 Expenditure Elasticities

Expenditure elasticity is a measure of how consumption react to the change in consumer total budget. The elasticity is normally positive meaning that consumption for certain good will increase as consumer total budget increase. The elasticity value can categorize certain good into necessity when the elasticity is less than one, and into luxury when the elasticity is higher than one. Necessity mean consumption for certain good change relatively smaller than the change in total budget, while luxury mean the consumption change relatively bigger than the change in total budget. The elasticity value used for this categorization is the unconditional elasticity.

The estimated conditional and unconditional expenditure elasticities for each region are reported in Appendix 4. Estimated expenditure elasticities are mostly statistically different from zero and relatively have small variation. All expenditure elasticities are found to be positive. Aggregate food elasticity in Java-Bali region found to be significantly lower than other regions, however they are relatively same in magnitude across regions with less than one elasticity value. Therefore, it makes all unconditional elasticity for disaggregated food classification is lower than the conditional elasticity.

The estimated unconditional elasticity categorized all most strategic food to be necessity in all regions, while processed food and other food items are found to be luxury in some regions. Elasticity for most strategic food is ranging from 0.2 – 0.9 with rice and flour are found to have lower elasticity, while fish and meat are found to have higher elasticity. However, some regions have variation in the rank for example the elasticity of egg is higher than meat in Sulawesi and Nusmapua regions. The elasticity of processed food and other food classifications is found to be higher than other food classifications in all regions with elasticity value around 0.9 – 1.1 that means they can be categorized as luxury in some regions.

The estimated elasticity in this study is found to be lower compared to similar previous studies that have comparable classification such as Boediono (1978), Timmer and Alderman (1979b), Teklu and Johnson (1987), Deaton (1990), Rachmat and Erwidodo (1993), Jensen and Manrique (1998), Saliem (2016) Faharuddin et al., (2017). Rice is one classification that commonly used in previous studies since it is the main staple of most Indonesian. The oldest expenditure elasticity found for rice is 0.68 and relatively declining as expected because rice become less luxurious for all consumers. Excluding the findings from Rachmat and Erwidodo (1993) and Jensen and Manrique (1998), the estimated elasticity from this study is in line with previous findings as it gets lower.

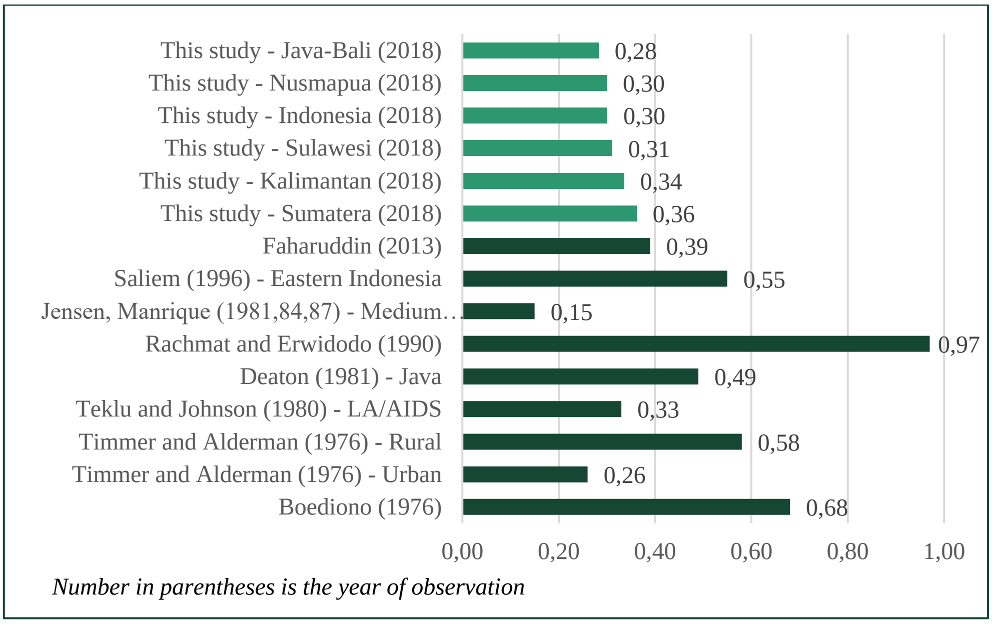

Figure 4 Expenditure Elasticity for Rice Across Different Studies

Relatively lower elasticity is also found for fish classification, however some studies within the time range produce lower elasticity. It is not clear from this picture how the trend for fish elasticity because this study found that the lowest elasticity is in Nusmapua region, therefore it is possible that there is higher variability of fish products for some regions or there is difference in consumer preference on fish across regions. The former is supported from the fact that consumers in Nusmapua enjoy higher fish availability as they have huge marine fisheries production, so they may satiate their utility from fish faster than other regions in Indonesia. The later become the reason because fish products variability may increase as consumer start to discover new way of consuming fish products, then they will put higher weight of their risen income into this classification.

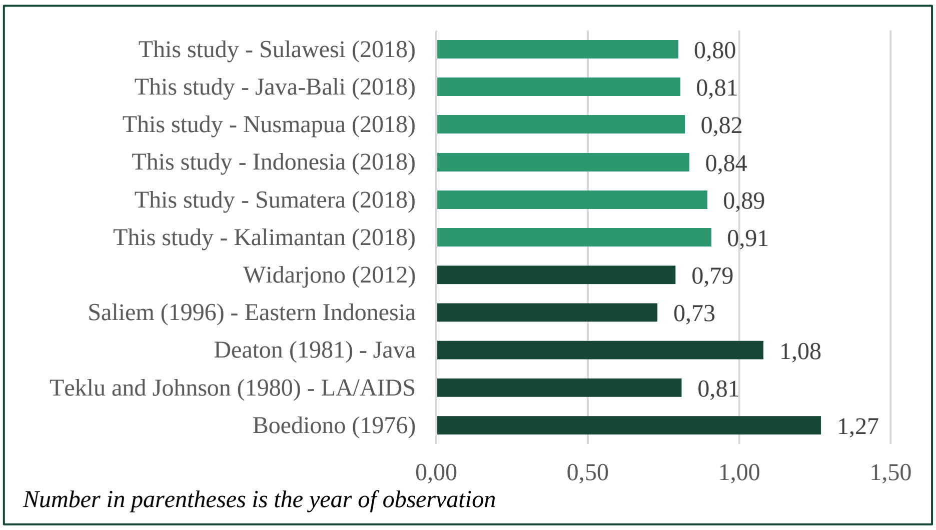

Figure 5 Expenditure Elasticity for Fish Products Across Different Studies

This finding can be explained in number of ways according to the stated hypothesis. First, the elasticity of food and non-food group confirms that consumption of non-food categories increase faster than food categories as household expenditure rises, resulting lower expenditure share on food. Second, there is variation within food group itself that show one can be more luxurious than another. Third, processed food and other food classifications have higher elasticity that can fuelled by relatively higher product variability within these classifications so larger room is available for consumers to expand their expenditure within these categories as the marginal utility schedule can be different for each product variant. Fourth, a variation across regions shows that there must be some unobserved variables that play important role in explaining consumption variability across regions.

The heterogeneity in expenditure elasticities across regions is illustrated in Figure 6 below. The elasticities variation can be seen clearly within this graph, especially for Sulawesi and Nusmapua regions. The most easily identified is the difference in chicken egg that is ranged from 0.80 in Nusmapua, 0.61 in Sulawesi, and 0.39 in Kalimantan. There is also a difference for other classifications, while not huge, it can make a difference in welfare impact measurement since the elasticity is used to calculate compensated elasticity and welfare impact of price increase.

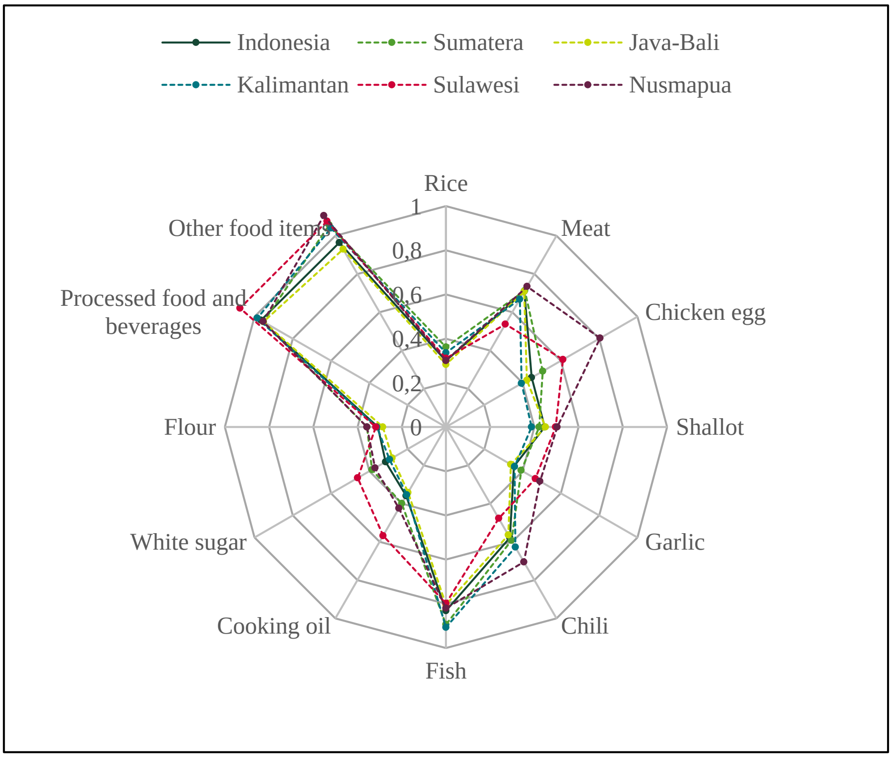

Figure 6 Comparing Conditional Expenditure Elasticities Across Indonesian Regions

6.2.3 Uncompensated/Marshallian Own-Price Elasticities

Uncompensated/Marshallian own-price elasticity is a measure of how consumption react to change in its price. The elasticity is expected to be negative for normal goods because consumers are expected to decrease their consumption of specific good when the price increase, except for special case of Veblen and Giffen goods. Marshallian is one type of own-price elasticity where both income and substitution effect of price changes is accounted, so it is the measure of how consumption react to change in price when their budget does not change. This measure can be used to evaluate how will consumption change as the price changes and for special case it can be used to assess welfare changes as explained by Willig (1976), however it is not the right measure because consumer surplus is not an exact money measure of welfare change.

The estimated elasticities are mostly negative and precise with low enough standard error except for rice elasticity in Nusmpua with imprecise positive value. The imprecise elasticity case for rice in Nusmapua may came from the high variation in rice preference between consumers within the area as some consumers use other source of carbohydrate as their main staple for example maize as identified by Myers *et al.*, (2014), cassava, certain roots, and sago. Since most of the conditional elasticity are negative and the unconditional elasticity for food is less than one then the unconditional elasticities are less elastic. The complete own-price conditional and unconditional elasticity is reported in Appendix 4.

The unconditional elasticities categorized most of classifications to be normal and inelastic to price change except rice classification for Nusmapua. Rice in Nusmapua is categorized as Giffen good since the unconditional elasticity is 0.09, however since the conditional elasticity is uncertain (i.e., the standard error is relatively high) then this elasticity number also uncertain. There are some commodities that found to be price elastic such as white sugar in Kalimantan and garlic in Sulawesi with each elasticity respectively are -1.04 and -1.08, therefore consumers in Kalimantan and Sulawesi relatively have higher tolerance for using less of that food products if their price increase.

The pattern of own-price elasticity findings is relatively the same as expenditure elasticity if compared to older studies. The pattern shows it become less elastic in newer study. The oldest study using 1976 survey data found that the uncompensated price elasticity of rice is -0.63 while this study found the elasticity to varied across regions from -0.62 in Kalimantan and 0.09 in Nusmapua. The pattern is also relatively the same for fish, however there is different pattern if we look at regional elasticity between rice and fish. The elasticity for fish is found to be more elastic in Sulawesi, while for rice it is more elastic in Kalimantan. These results may suggest that the consumption behaviour with respect to price may change as economic develop and it may vary between different locations.

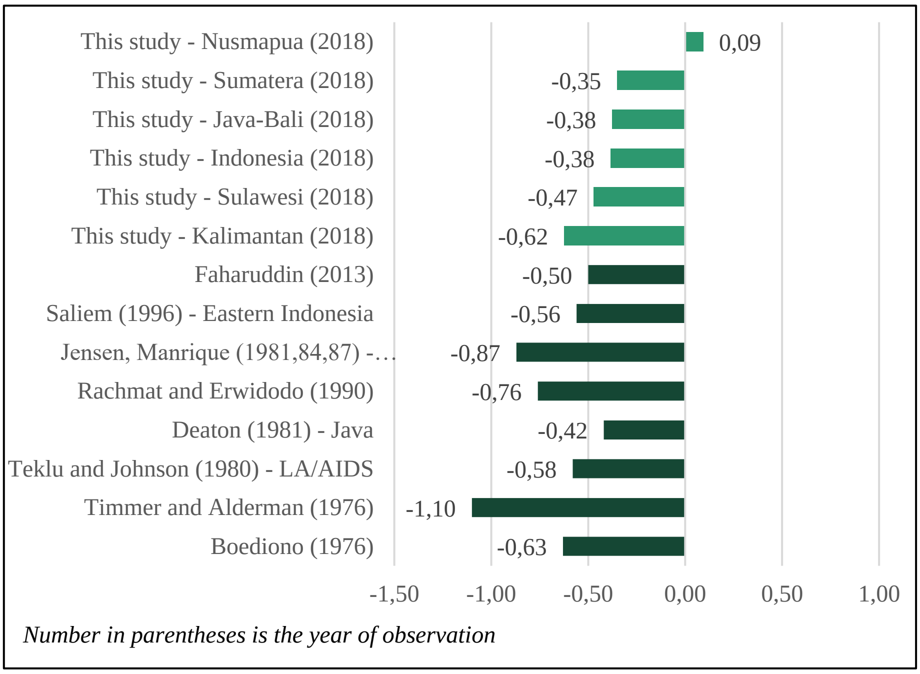

Figure 7 Rice Uncompensated Price Elasticity Across Studies

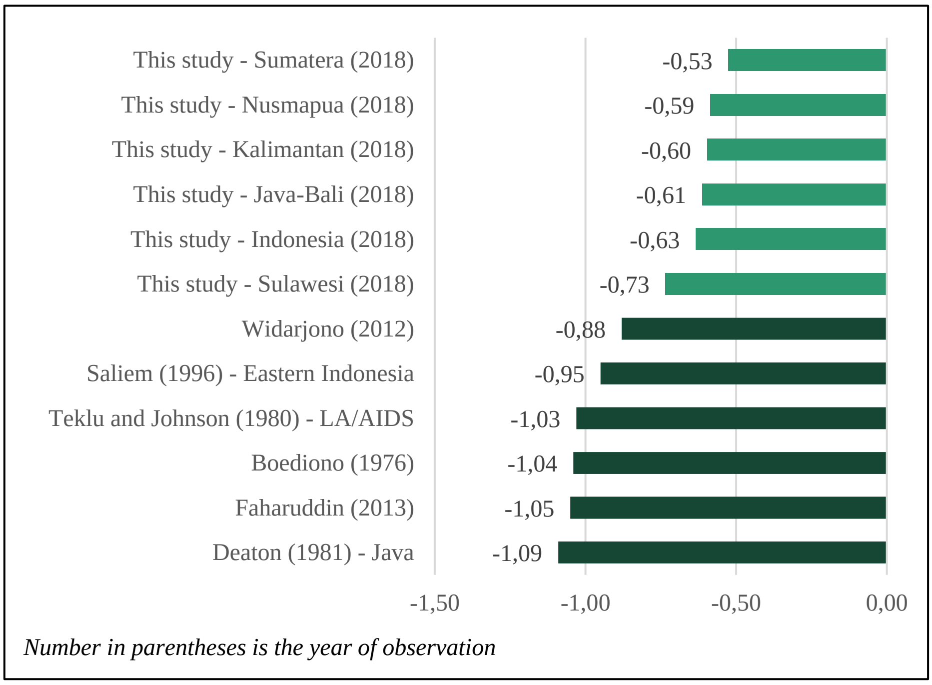

Figure 8 Fish Uncompensated Price Elasticity Across Studies

The complete heterogeneity in own-price elasticities can be easily observed from Figure 9 for each food classification. This figure excludes the elasticity of rice for Java-Bali and Nusmapua regions because, they are positive. The figure shows the difference in price elasticities across regions that reflect the difference in consumer reaction from price changes for example household in Sulawesi tend to have less changes in quantity demanded for most strategic commodities except flour and white sugar in the presence of price changes. This difference can be substantial and may not converge within short period because it is found to change only a little for long period of observations. Therefore, the welfare impact of price increase may also differ across regions.

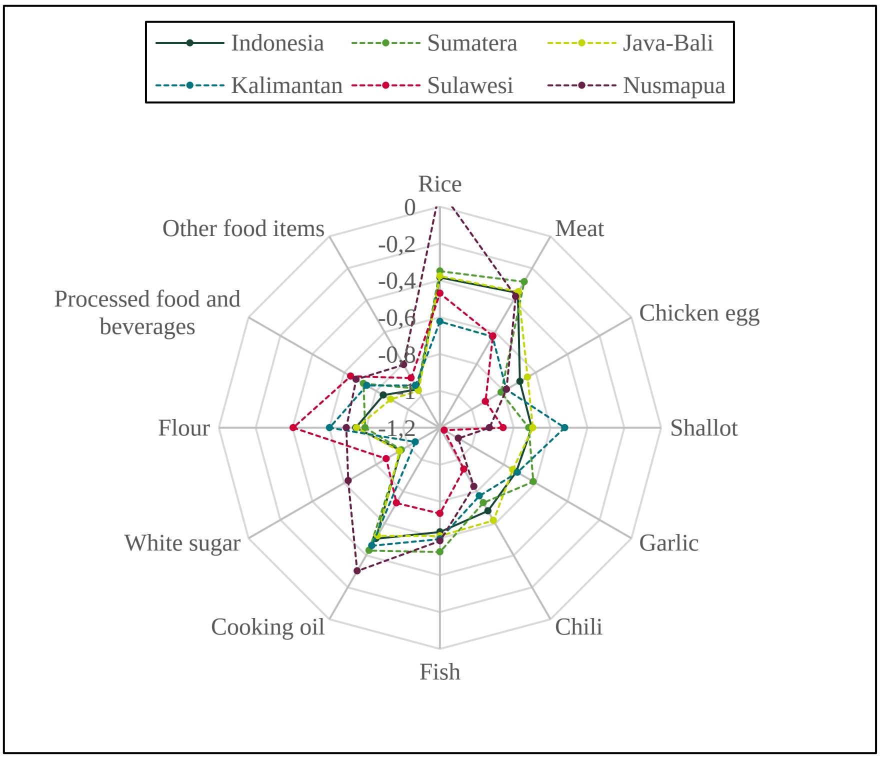

Figure 9 Comparing Conditional Uncompensated Own-Price Elasticities Across Indonesian Regions

6.2.4 Compensated/Hicksian Own-Price Elasticities

Compensated or Hicksian own-price elasticities is another measure of how consumer react to change in price. The measure also categorized goods like uncompensated price elasticity. The difference is compensated price elasticity measure how consumer react as if their budget can adjust to keep the utility level the same as before price change. This characteristic allows the elasticity to be used to get the money measure of welfare impact of price changes, in the case of this study with price increase then it can be used to calculate Compensating Variation (CV) or consumer willingness to accept for each increase in price. Therefore, since the explanation is relatively the same as uncompensated elasticity then the elasticities are reported in Appendix 4.

6.2.5 Cross-Price Elasticity

The cross-price elasticity number can categorize substitutivity and complementarity between two commodities. If the cross-price elasticity value is negative, then the two commodities are complements while if the cross-price value is positive then the two commodities are substitutes. The degree of complementarity and substitutivity are measured by the absolute value number. This section presents the estimated cross-price elasticity for each region.

Indonesia

The estimated cross-price elasticity for Indonesia by each classification are presented in Table 13. Most commodities are responds negatively to rice price (*p1*) except egg, garlic, and processed food, so that they are mostly complement to rice. This can be interpreted as the price of rice higher, then the demand of most commodities is lower, except the demand for egg, garlic, and processed food that expected to be higher. This interpretation is not surprising because consumer may replace their carbohydrate from rice to other option such as noodle and at the same time because the expenditure needed for carbohydrate increase then they must substitute their protein needs to cheaper one such as egg. However, we do not see symmetry here because the demand for rice respond negatively to processed food price which means they are both complements.

Table 13 Uncompensated Cross Price Elasticity for Indonesia

	p1	*p2*	*p3*	*p4*	*p5*	*p6*
(1) Rice	-0.38	-0.05	0.17	-0.03	0.00	-0.02
(2) Meat	-0.10	-0.35	0.01	0.01	0.00	-0.02
(3) Egg	0.09	-0.03	-0.70	0.04	-0.03	-0.01
(4) Shallot	-0.15	-0.01	0.11	-0.70	-0.12	0.04
(5) Garlic	0.16	0.00	-0.01	-0.03	-0.72	-0.01
(6) Chili	-0.37	-0.04	0.09	0.09	-0.05	-0.68
(7) Fish	-0.31	0.12	-0.08	0.05	0.01	-0.04
(8) Cooking oil	-0.18	-0.01	0.11	0.08	-0.02	0.01
(9) Sugar	-0.15	0.04	0.27	0.12	-0.02	-0.07
(10) Flour	-0.02	0.04	0.25	0.12	-0.05	-0.03
(11) Processed food..	0.05	-0.06	-0.13	-0.04	0.03	-0.01
(12) Other food items	-0.11	-0.04	0.06	0.03	0.00	0.03
	p7	*p8*	*p9*	*p10*	*p11*	*p12*
(1) Rice	-0.01	-0.03	0.00	-0.01	-0.20	-0.07
(2) Meat	-0.08	-0.04	0.07	-0.11	0.04	0.02
(3) Egg	-0.01	0.04	0.04	-0.06	0.00	0.01
(4) Shallot	0.02	0.05	0.02	-0.01	0.09	0.03
(5) Garlic	0.01	0.12	0.03	0.02	0.15	0.05
(6) Chili	0.05	0.09	0.01	0.06	0.05	-0.02

(7) Fish	-0.63	-0.01	0.04	-0.04	-0.02	0.00
(8) Cooking oil	0.01	-0.50	-0.02	-0.02	-0.04	-0.03
(9) Sugar	0.01	-0.06	-0.95	-0.04	-0.04	-0.04
(10) Flour	0.01	0.00	0.07	-0.74	-0.06	-0.06
(11) Processed food..	-0.03	-0.01	0.01	0.03	-0.84	0.00
(12) Other food items	-0.03	0.00	-0.02	0.01	-0.08	-0.96

Source: Author's calculation

Sumatera

The general interpretation for Sumatera region is relatively like overall Indonesia. The demand for most commodities is also responded negatively to rice price except processed food. Here egg does not respond positively as in overall Indonesia case, therefore it is also a complement to rice. However, symmetry is also rejected in this case because the demand for rice is expected to be lower when the price of processed food higher.

Table 14 Uncompensated Cross Price Elasticity for Sumatera

	p1	*p2*	*p3*	*p4*	*p5*	*p6*
(1) Rice	-0.35	-0.04	0.18	0.04	-0.03	-0.06
(2) Meat	-0.14	-0.29	-0.19	-0.02	0.01	-0.17
(3) Egg	-0.12	0.01	-0.82	-0.02	-0.01	-0.05
(4) Shallot	-0.14	-0.05	0.00	-0.72	0.04	-0.02
(5) Garlic	-0.25	0.07	-0.06	-0.05	-0.61	-0.14
(6) Chili	-0.03	-0.01	-0.14	-0.01	-0.03	-0.73
(7) Fish	-0.38	0.03	-0.14	0.12	-0.06	0.02
(8) Cooking oil	-0.12	-0.05	-0.04	0.04	-0.01	-0.03
(9) Sugar	-0.29	-0.04	0.23	0.19	-0.12	-0.03
(10) Flour	-0.22	-0.01	0.14	0.11	-0.08	-0.02
(11) Processed food..	0.18	-0.02	-0.14	-0.06	0.04	0.08
(12) Other food items	-0.16	-0.07	0.13	0.00	0.02	-0.02
	p7	*p8*	*p9*	*p10*	*p11*	*p12*
(1) Rice	-0.03	-0.21	0.01	0.00	-0.11	-0.06
(2) Meat	-0.07	0.07	0.01	0.07	-0.04	0.06
(3) Egg	0.04	0.19	-0.04	-0.10	-0.10	0.02
(4) Shallot	-0.11	0.30	0.04	0.17	-0.06	-0.03
(5) Garlic	0.01	0.29	0.07	0.05	-0.02	-0.02
(6) Chili	0.00	-0.13	0.00	0.02	-0.05	-0.04
(7) Fish	-0.53	0.13	0.00	0.03	-0.12	-0.02
(8) Cooking oil	0.00	-0.43	-0.03	-0.04	-0.09	-0.01
(9) Sugar	0.02	0.14	-0.96	-0.13	-0.13	-0.09
(10) Flour	0.13	0.17	0.00	-0.79	-0.06	-0.03
(11) Processed food..	-0.13	0.01	0.00	-0.02	-0.72	0.00

(12) Other food items	-0.01	-0.04	0.01	0.01	-0.10	-0.95

Source: Author's calculation

Java-Bali

The cross-price elasticity results interpretation related to rice price is relatively the same as overall Indonesia case, however there is some variation found. Here most of commodities are respond negatively to rice price, therefore most of them are complements except egg, garlic, flour, and processed food. Here flour also found to be substitute for rice. However, the symmetry also does not fulfil within this region.

Table 15 Uncompensated Cross Price Elasticity for Java-Bali

	p1	*p2*	*p3*	*p4*	*p5*	*p6*
(1) Rice	-0.38	-0.06	0.15	-0.03	-0.01	-0.02
(2) Meat	-0.11	-0.35	0.01	0.02	-0.01	0.00
(3) Egg	0.12	-0.03	-0.65	0.04	-0.04	-0.01
(4) Shallot	-0.16	-0.01	0.06	-0.70	-0.18	0.06
(5) Garlic	0.25	-0.03	-0.06	-0.03	-0.74	0.01
(6) Chili	-0.57	-0.05	0.12	0.10	-0.07	-0.62
(7) Fish	-0.35	0.18	-0.06	0.05	0.05	-0.04
(8) Cooking oil	-0.20	0.01	0.14	0.10	-0.02	0.02
(9) Sugar	-0.09	0.04	0.27	0.11	-0.04	-0.11
(10) Flour	0.02	0.05	0.24	0.13	-0.08	-0.02
(11) Processed food..	0.04	-0.05	-0.11	-0.05	0.03	-0.02
(12) Other food items	-0.11	-0.05	0.03	0.04	-0.01	0.03
	p7	*p8*	*p9*	*p10*	*p11*	*p12*
(1) Rice	-0.01	-0.01	0.00	-0.01	-0.23	-0.06
(2) Meat	-0.10	-0.08	0.08	-0.16	0.07	0.00
(3) Egg	-0.02	-0.02	0.05	-0.05	0.04	0.01
(4) Shallot	0.02	0.00	0.02	-0.06	0.15	0.05
(5) Garlic	0.00	0.08	0.01	-0.01	0.21	0.06
(6) Chili	0.05	0.16	0.01	0.05	0.09	0.00
(7) Fish	-0.61	-0.03	0.06	-0.07	0.03	0.01
(8) Cooking oil	0.01	-0.52	-0.03	-0.02	-0.03	-0.04
(9) Sugar	0.00	-0.15	-0.95	-0.01	0.00	-0.02
(10) Flour	-0.01	-0.08	0.09	-0.75	-0.04	-0.08
(11) Processed food..	-0.02	0.00	0.01	0.05	-0.89	0.00
(12) Other food items	-0.04	0.00	-0.03	0.00	-0.06	-0.97

Source: Author's calculation

Kalimantan

The results interpretation related to rice in Kalimantan is somewhat different from overall Indonesia case and other previous regions discussed. This is because many commodities are found to respond positively with rice price increase. These commodities are meat, egg, garlic, chili, flour, and other food items. Unlike other previous regions discussed, it is found that processed food responds negatively to rice price. Here we found some symmetry in the direction related to rice price such as meat, egg, garlic, chili, and flour.

Table 16 Uncompensated Cross Price Elasticity for Kalimantan

	p1	*p2*	*p3*	*p4*	*p5*	*p6*
(1) Rice	-0.62	0.01	0.32	-0.07	0.11	0.04
(2) Meat	0.68	-0.63	-0.03	0.02	0.00	0.00
(3) Egg	0.17	-0.02	-0.78	0.06	-0.04	-0.05
(4) Shallot	-0.16	0.11	0.36	-0.52	-0.23	-0.04
(5) Garlic	0.04	0.08	0.32	-0.01	-0.71	-0.11
(6) Chili	0.83	0.07	0.26	0.13	0.15	-0.77
(7) Fish	-0.06	0.08	0.20	-0.04	0.05	-0.05
(8) Cooking oil	-0.01	-0.05	0.09	-0.04	-0.01	-0.01
(9) Sugar	-0.26	0.10	0.07	0.19	-0.10	0.03
(10) Flour	0.16	0.08	0.42	0.06	0.07	-0.11
(11) Processed food..	-0.33	-0.08	-0.28	0.07	-0.04	-0.01
(12) Other food items	0.13	0.01	0.10	-0.05	0.02	0.05
	p7	*p8*	*p9*	*p10*	*p11*	*p12*
(1) Rice	-0.05	0.00	-0.03	0.06	-0.14	-0.06
(2) Meat	-0.04	0.40	-0.06	-0.05	-0.08	0.04
(3) Egg	-0.10	0.39	0.02	-0.12	-0.07	0.02
(4) Shallot	-0.08	0.02	-0.07	-0.01	-0.10	-0.03
(5) Garlic	-0.07	0.44	0.01	0.12	0.07	0.03
(6) Chili	-0.41	-0.11	0.04	0.14	-0.01	-0.04
(7) Fish	-0.60	-0.21	0.03	-0.12	-0.10	-0.04
(8) Cooking oil	-0.07	-0.46	0.03	0.03	0.02	0.00
(9) Sugar	-0.03	0.09	-1.05	-0.14	-0.25	-0.08
(10) Flour	-0.12	0.29	-0.01	-0.60	-0.16	-0.04
(11) Processed food..	-0.10	-0.11	0.02	0.04	-0.74	0.00
(12) Other food items	0.05	0.07	0.02	0.02	-0.13	-0.94

Source: Author's calculation

Sulawesi

The results interpretation related to rice price is also somewhat different in Sulawesi compared to overall Indonesia, Sumatera, and Java-Bali regions. Here there are more commodities that found to respond positively with rice price increase. These includes egg, shallot, garlic, chili, and processed food. The degree of substitutivity is also found to be higher as the cross-price elasticity for egg, shallot, garlic, and chili respectively are 0.28, 0.33, 0.35, and 0.88. However, here the symmetry in the direction found only for egg and chili.

Table 17 Uncompensated Cross Price Elasticity for Sulawesi

	p1	*p2*	*p3*	*p4*	*p5*	*p6*
(1) Rice	-0.47	0.01	0.21	-0.04	-0.01	0.03
(2) Meat	-0.09	-0.63	0.33	-0.07	0.00	-0.11
(3) Egg	0.28	-0.09	-0.91	0.08	0.02	-0.04
(4) Shallot	0.33	0.03	-0.09	-0.86	-0.02	0.02
(5) Garlic	0.35	-0.01	-0.35	0.36	-1.17	-0.02
(6) Chili	0.88	-0.07	-0.28	0.10	-0.01	-0.94
(7) Fish	-0.12	0.01	-0.17	-0.09	0.04	-0.11
(8) Cooking oil	-0.10	-0.06	-0.07	0.14	-0.08	-0.07
(9) Sugar	-0.27	0.01	-0.18	-0.05	0.06	0.00
(10) Flour	-0.23	0.05	0.19	0.10	-0.16	0.11
(11) Processed food..	0.13	-0.13	-0.04	0.07	0.08	0.02
(12) Other food items	-0.22	0.11	0.04	0.03	-0.03	0.09
	p7	*p8*	*p9*	*p10*	*p11*	*p12*
(1) Rice	-0.01	-0.10	-0.19	-0.13	-0.15	-0.09
(2) Meat	-0.10	-0.17	0.05	-0.05	-0.02	-0.02
(3) Egg	-0.10	-0.03	-0.12	0.28	-0.26	-0.03
(4) Shallot	-0.17	-0.13	-0.14	0.11	-0.05	0.06
(5) Garlic	-0.37	-0.30	-0.06	0.41	0.13	0.15
(6) Chili	0.04	-0.06	-0.08	0.42	-0.07	0.02
(7) Fish	-0.73	0.10	-0.02	-0.05	-0.13	0.04
(8) Cooking oil	-0.05	-0.73	0.02	0.02	-0.12	-0.10
(9) Sugar	-0.10	0.33	-0.86	0.12	-0.13	-0.09
(10) Flour	-0.23	-0.01	-0.03	-0.40	-0.17	-0.10
(11) Processed food..	-0.02	0.14	0.03	0.01	-0.64	-0.03
(12) Other food items	0.02	-0.07	0.09	0.05	-0.15	-0.89

Source: Author's calculation

Nusmapua

The cross-price elasticity results interpretation related to rice in Nusmapua is somewhat different from all regions. Here it is found that the own-price elasticity for rice is positive, while most other commodities are found to be negative. Possible explanation for this unexpected result is from the fact that rice is not necessarily the main staple in this region, so it does not respond to price accordingly like normal commodity. The main staples in this region can vary between cassava, maize, certain roots, and sago. Meanwhile, it is found that the demand of most commodities is expected to be lower for higher rice price in this region except chili, cooking oil, and processed food. Symmetry is also hardly found.

Table 18 Uncompensated Cross Price Elasticity for Nusmapua

	p1	*p2*	*p3*	*p4*	*p5*	*p6*
(1) Rice	0.09	0.01	-0.13	-0.14	0.15	-0.16
(2) Meat	-0.64	-0.38	0.14	0.13	0.22	-0.13
(3) Egg	-0.24	-0.08	-0.78	0.01	0.18	0.01
(4) Shallot	-0.31	-0.04	0.22	-0.93	-0.05	0.06
(5) Garlic	-0.60	0.07	-0.01	0.03	-1.08	0.06
(6) Chili	0.18	-0.26	0.29	-0.05	-0.03	-0.83
(7) Fish	-0.07	-0.07	-0.16	0.05	0.03	-0.01
(8) Cooking oil	0.10	-0.09	0.24	0.12	0.03	-0.15
(9) Sugar	-0.51	0.07	-0.11	0.09	0.15	-0.18
(10) Flour	-0.42	0.05	0.13	0.29	0.24	-0.19
(11) Processed food..	0.39	-0.02	0.04	0.01	-0.05	0.16
(12) Other food items	-0.42	0.00	0.04	0.04	-0.01	0.02
	p7	*p8*	*p9*	*p10*	*p11*	*p12*
(1) Rice	-0.05	0.18	0.50	0.12	-0.25	0.07
(2) Meat	0.21	0.47	-0.11	-0.44	0.00	0.03
(3) Egg	0.20	0.22	-0.03	0.08	-0.11	-0.19
(4) Shallot	0.09	-0.06	0.31	0.16	-0.22	-0.06
(5) Garlic	0.14	-0.05	0.51	-0.03	-0.18	-0.06
(6) Chili	0.27	-0.28	-0.04	0.42	-0.26	-0.06
(7) Fish	-0.59	0.45	0.00	-0.04	0.00	-0.06
(8) Cooking oil	0.03	-0.30	0.16	-0.09	-0.18	-0.07
(9) Sugar	0.14	0.25	-0.63	0.02	-0.07	-0.13
(10) Flour	0.18	0.82	0.36	-0.69	-0.12	0.06
(11) Processed food..	-0.14	-0.55	-0.24	0.14	-0.67	-0.14
(12) Other food items	-0.02	0.16	0.06	-0.03	-0.07	-0.81

Source: Author's calculation

6.3 Welfare Impact of Price Increase Events

The welfare impact from two different events is estimated. It is show that overall, the amount of compensation needed is way higher in Event II. This difference is produced by the variation in price changes structure between two events. However, the implication from the change in welfare between two events are beyond the scope of this study because there are many signs of social stress found during Event I period as people demand lower cooking oil price while there is no sign of social stress during Event II period where the welfare impact is way higher. The possible explanation for this paradox is that at the same time consumers income are lower during Event I period because of Covid-19 pandemic, while the holiday allowance that consumers received during Event II period may surpass the negative welfare impact from price increase. This section presents and discuss the welfare impact from these two events respectively.

6.3.1 Event I

The estimated change in quantity based on Event I and Hicksian demand elasticity is presented in Appendix 5. The highest change in quantity as expected is cooking oil with 19.7 percent decline on average. The highest consumption decline is estimated in Java-Bali region with 25.2 percent lower, while the lowest decline is in Nusmapua region with 9.4 percent lower. The estimated response for other commodities is varied between regions as the percentage price change also varies.

The estimated compensating variation suggest that household welfare does not necessarily decline in all regions during the period. The total CV for Indonesia household is IDR 14,512 per week which means they are willing to accept that amount as a compensation to keep their welfare unchanged. However, if regional heterogeneity is considered then the estimated CV does not represent most of Indonesian household because households in Java-Bali and Sumatera regions are better off during this period while households in Kalimantan need IDR 51,827 per week compensation to keep their welfare unchanged. The reason for this condition is that households in Java-Bali and Sumatera regions experience other commodity price decline that can compensate for higher cooking oil price.

Table 19 Compensating Variation Results from Event 1 (IDR/Week)

Commodity	Compensating Variation - Jan 2022 (5)					
	Indonesia	Sumatera	Java-Bali	Kalimantan	Sulawesi	Nusmapua
Rice	- 2,987.28	- 3,181.42	- 356.85	14,515.07	512.63	5,282.98
Meat	1,496.28	213.99	1,344.98	1,670.85	314.61	- 776.53
Chicken egg	619.16	339.14	- 152.80	782.48	- 63.25	1,874.76
Shallot	88.48	53.03	- 12.66	- 118.77	173.15	240.93
Garlic	- 45.90	- 24.55	- 0.09	115.37	- 74.26	165.24
Chili	- 64.00	- 1,899.67	- 687.15	124.21	- 226.71	- 580.07
Fish	370.00	594.49	- 422.48	- 3,295.74	871.20	4,792.00
Cooking oil	1,089.77	2,392.89	503.67	2,488.20	129.37	2,846.85
White sugar	- 48.71	- 114.91	- 115.80	50.23	52.86	200.86
Flour	- 81.15	- 176.10	- 48.82	54.23	118.75	- 70.18
Processed food	7,034.11	- 1,926.87	- 11,842.12	18,140.18	3,593.56	- 58.20
Other food items	7,041.06	3,622.54	- 4,772.49	17,300.54	7,135.28	12,542.10
Total	14,512	- 107	- 16,563	51,827	12,537	26,461

Source: Author's calculation

6.3.2 Event II

The change in quantity demanded results from price changes during Event II is reported in Appendix 5. The biggest change in quantity is estimated for garlic, chili, and shallot as the price of these commodities immensely higher during this period. However, the changes are not evenly distributed across regions because for example Sulawesi experience higher percentage change in rice and flour while Nusmapua region also experience high changes in rice and white sugar. The direction of the change is also varied between regions for example demand for rice is increase in Sulawesi region while in Nusmapua region it decreases.

The resulting CV estimates are also varied between regions. Overall total CV for Indonesia is IDR 67,911 per week during the period which means consumer are willing to accept that amount of compensation to keep their utility level unchanged because of some commodities price increase. However, the amount of compensation is not the same when considering regional heterogeneity for example it is IDR 73,041 per week in Sulawesi while it is only IDR 3,954 per week in Nusmapua.

Table 20 Compensating Variation Results from Event II (IDR/Week)

Commodity	Compensating Variation - Mei 2019 (IV)					
	Indonesia	Sumatera	Java-Bali	Kalimantan	Sulawesi	Nusmapua
Rice	1,637.29	- 6,002.01	- 1,221.78	10,257.17	22,560.39	- 21,946.34
Meat	526.47	1,386.18	492.51	3,579.63	1,161.42	- 185.57
Chicken egg	682.58	- 503.20	268.96	4,085.63	- 2,529.82	1,128.70
Shallot	187.47	48.28	186.29	565.50	989.32	- 151.66
Garlic	- 200.39	222.94	- 136.02	- 139.09	- 1,031.13	- 1,841.65
Chili	392.32	- 552.99	434.32	- 307.91	- 68.05	664.85
Fish	1,853.78	1,373.88	990.26	- 4,061.82	- 9,189.11	8,871.34
Cooking oil	712.85	1,458.53	284.61	2,198.72	- 1,764.70	- 994.41
White sugar	163.87	346.65	81.80	- 67.72	- 564.46	3,079.45
Flour	41.06	251.83	- 24.86	287.62	1,582.61	638.69
Processed food	38,326.29	12,369.76	40,667.28	22,757.16	25,563.38	- 3,674.64
Other food items	23,587.42	18,386.99	19,610.40	20,276.65	36,331.18	18,365.68
Total	67,911	28,787	61,634	59,432	73,041	3,954

Source: Author's calculation

7. Conclusion

This study observed overall food share expenditure is decreasing starting from the lowest expenditure level and considering non-linearity it decreases even more faster at higher expenditure level. Most of the strategic commodities are found to be inelastic to both expenditure and price changes in all regions, however some are found to be more elastic than other. Regional heterogeneity is found to play an important role in explaining food consumption pattern in Indonesia and the difference in elasticity magnitude can be substantial for some commodities such as egg because this study found that the magnitude does not change much for long period of time based on some previous study findings. Therefore, supporting the first five hypotheses and implying the support for the last hypothesis about welfare impact.

Welfare impact of two price increase events is estimated. It is found that the welfare impact can be substantially varied between regions during the same event because each commodity price might move in different direction. The welfare impact from cooking oil price increase in early 2022 is found to be less than price increase during Eid celebration in 2019 and each region have different welfare impact. However, the implication for this welfare impact is beyond the scope of this study because there are many signs of social stress during cooking oil price increase while no sign during 2019 Eid celebration. This study suggests that the negative welfare impact from Covid-19 during cooking oil price increase and positive welfare impact from holiday allowance during 2019 Eid celebration might respectively amplify and surpass the negative welfare impact from these two events.

There are some policy alternatives that can be derived from this study. First, the focus of agricultural product development may be different for each region for example since the meat price elasticity is low in some regions then it may be good to introduce additional marketable services that came along with the product while in some regions it may be better to increase its availability either by encouraging production in the area or by inducing interregional trade. Second, it may be better to consider welfare impact measurement based on regional elasticities estimates in considering compensation or evaluating regional economic policies related to food such as yearly evaluation of TPID. Third, estimating elasticities for lower administrative level may enrich the information about consumer behaviour and may be useful for policy consideration that can be taken in each administrative level.

This study focuses to the consumer side and the heterogeneity across regions; therefore, it neglects the production side of food and the role of other demographics such as income group and urban/rural classifications that are discussed in previous studies. Limited discussion for each commodity classification is also a feature of this study that may be extended in further study. The use of real price measure rather than adjusted unit value may also be the next study agenda because it may produce more reliable estimates. Related to the demand system estimation, this study hardly found the symmetry assumption to be satisfied with unrestricted estimation, therefore may limit the prediction power of welfare impact, while on the other side the use of restricted estimation is found to be unattainable.

Appendix 1 – Food Classification Details

Table 21 Detailed Food Classifications

Classifications	Details
Rice	Rice
Meat	Beef and broiler chicken
Egg	Broiler egg
Shallot	Shallot
Garlic	Garlic
Chili	Red chili, green chili, cayenne pepper
Fish	Fisheries products
Cooking oil	Cooking oil from palm or sunflower
White sugar	Sugar
Flour	Flour
Processed food and bev.	Instant noodle, crisp, packed baby porridge, white bread, sweet bread, cookies, cake, fries, prepared foods (*gado-gado, ketoprak, green bean porridge, sate, tongseng, bakso,* etc), sausage, bottled water, bottled juice, prepared drinks (coffee, tea, chocolate, etc), ice cream, alcohol
Other food items	Other food items including cigarettes and tobacco

Appendix 2 – Unit Value Adjustment

The estimation results for price quality adjustment have positive and significance sign of expenditure coefficient, however the sign is mixed for the rest of explanatory variables. The sign for expenditure is positive and statistically different from zero for all food classifications as expected because consumer with higher expenditure tend to choose higher quality product. The sign for size is mostly negative and statistically different from zero but some classifications have positive coefficient, while the sign for age is the opposite. The sign for urban is mixed by classifications, however for aggregated group the sign is positive. The model fit relatively better for aggregate classifications with aggregate food and non-food respectively have 0.35 and 0.39 R-squared, while the rest is still relatively well fit compared to the estimation done by Cox and Wohlgenant (1986) and Goldman and Grossman (1978) which produce 0.03 – 0.18 R-squared. The reason for this may come from the fact that there are relatively more varieties in quality for aggregated classifications. Other reason may include the fact that each consumer can negotiate the price of listed commodities and the seller may discriminate the price based on consumer available budget to make trade happen in many Indonesian traditional markets, therefore the price faced by consumers is a function of their total budget.

Table 22 Price Quality Adjustment Estimates Sign and Significance

Classification	Constant	Expend.	Size	Age	Urban	R^2
Aggregate Classification						
Food	(+)***	(+)***	(-)***	(+)***	(+)***	0.33
Non-Food	(+)***	(+)***	(-)***	(+)***	(+)***	0.39
Food Classification						
Rice	(+)***	(+)***	(-)***	(+)**	(-)***	0.35
Meat	(+)***	(+)***	(-)***	(+)***	(-)***	0.21
Chicken egg	(+)***	(+)***	(-)***	(-)***	(-)***	0.33
Shallot	(+)***	(+)***	(-)***	(-)***	(-)***	0.22
Garlic	(+)***	(+)***	(+)***	(-)***	(+)***	0.13

Classification	Constant	Expend.	Size	Age	Urban	R^2
Chili	(+)***	(+)***	(-)***	(-)	(-)***	0.23
Fish	(+)***	(+)***	(+)***	(+)***	(+)***	0.24
Cooking oil	(+)***	(+)***	(+)***	(-)	(+)***	0.24
White sugar	(+)***	(+)***	(-)***	(-)***	(-)***	0.10
Flour	(+)***	(+)***	(-)***	(+)	(-)***	0.13
Processed food and beverages	(+)***	(+)***	(+)***	(-)***	(+)***	0.35
Other food items	(+)***	(+)***	(+)***	(+)**	(+)***	0.19
Notes: province and education dummies are included in all equations, sign of the estimate in parentheses, *** p<0.01, ** p<0.05, * p<0.1						

Source: Author's calculation

The difference between mean of unit value and quality adjusted price is relatively mixed between classifications, however there is an expected difference in standard deviation value. The highest difference is in aggregate non-food classification which reach 75.9 percent from original unit value, while the smallest difference is white sugar which only 0.8 percent. The quality adjusted price tends to have lower standard deviation from its original unit value measure. This difference in standard deviation may picture how quality correction play a role in adjusting the price, so there is lower variation across households. This also mean that the use of original unit value measure will not produce good estimates because the variation come from the difference in product quality preferred by the consumer. Therefore, the results can be useful for generating better quality estimates for the demand system and for restoring some observations with missing unit value data.

Table 23 Mean of Unit Value and Adjusted Price Comparison

Food Classification	Mean Unit Value	Mean Adjusted Price	Mean Difference	% Mean Difference
Aggregate Classification				
Food	10,985 (7,382)	9,120 (2,262)	1,865	17.0
Non-Food	150,284 (226,821)	36,164 (28,138)	114,120	75.9
Food Classification				

Food Classification	Mean Unit Value	Mean Adjusted Price	Mean Difference	% Mean Difference
Rice	9,793 (2,169)	10,038 (1,210)	245	2.5
Meat	37,482 (21,536)	32,195 (10,412)	5,287	14.1
Chicken egg	1,414 (327)	1,513 (189)	99	7.0
Shallot	2,585 (1,362)	2,712 (884)	127	4.9
Garlic	3,087 (1,423)	3,001 (886)	87	2.8
Chili	34,562 (15,890)	35,227 (10,431)	665	1.9
Fish	20,375 (11,979)	22,165 (8,182)	1,790	8.8
Cooking oil	12,200 (3,047)	12,047 (1,577)	153	1.3
White sugar	1,511 (1,263)	1,523 (756)	12	0.8
Flour	8,031 (2,058)	8,523 (1,416)	492	6.1
Processed food and beverages	5,085 (2,868)	4,365 (1,209)	721	14.2
Other food items	10,884 (14,221)	5,893 (2,701)	4,991	45.9

Notes: numbers in () are standard deviation and all values in Indonesian Rupiah (IDR) with SEK 1 is around IDR 1,500

Source: Author's calculation

Appendix 3 – Estimation Results

Complete Estimation Summary

Table 24 Quadratic Almost Ideal Demand System Estimation Summary

Region	Equation	Obs	Parms	RMSE	"R-sq"	F	Prob > F
Indonesia	foodshare	3.00E+05	45	0.11	0.43	5028.03	0
Indonesia	nfoodshare	3.00E+05	45	0.11	0.43	5028.03	0
Indonesia	w1	32750	55	0.04	0.50	592.03	0
Indonesia	w2	32750	55	0.03	0.12	79.23	0
Indonesia	w3	32750	55	0.01	0.12	77.34	0
Indonesia	w4	32750	55	0.01	0.23	181.34	0
Indonesia	w5	32750	55	0.01	0.27	221.67	0
Indonesia	w6	32750	55	0.01	0.26	203.53	0
Indonesia	w7	32750	55	0.04	0.25	194.29	0
Indonesia	w8	32750	55	0.01	0.30	251.05	0
Indonesia	w9	32750	55	0.01	0.35	315.27	0
Indonesia	w10	32750	55	0.01	0.24	184.55	0
Indonesia	w11	32750	55	0.11	0.22	165.91	0
Indonesia	w12	32750	55	0.10	0.09	57.93	0
Java-Bali	foodshare	1.00E+05	18	0.11	0.47	5044.44	0
Java-Bali	nfoodshare	1.00E+05	18	0.11	0.47	5044.44	0
Java-Bali	w1	17147	28	0.04	0.52	651.07	0
Java-Bali	w2	17147	28	0.03	0.11	74.58	0
Java-Bali	w3	17147	28	0.01	0.12	85.11	0
Java-Bali	w4	17147	28	0.01	0.21	166.00	0
Java-Bali	w5	17147	28	0.01	0.28	242.62	0
Java-Bali	w6	17147	28	0.01	0.12	79.68	0
Java-Bali	w7	17147	28	0.04	0.14	99.92	0
Java-Bali	w8	17147	28	0.01	0.30	264.11	0
Java-Bali	w9	17147	28	0.01	0.35	330.24	0
Java-Bali	w10	17147	28	0.00	0.20	152.55	0
Java-Bali	w11	17147	28	0.11	0.17	122.39	0
Java-Bali	w12	17147	28	0.10	0.07	48.27	0
Kalimantan	foodshare	29217	16	0.10	0.38	1105.25	0
Kalimantan	nfoodshare	29217	16	0.10	0.38	1105.25	0
Kalimantan	w1	3878	26	0.03	0.46	124.63	0
Kalimantan	w2	3878	26	0.03	0.12	19.73	0
Kalimantan	w3	3878	26	0.02	0.14	23.53	0
Kalimantan	w4	3878	26	0.00	0.28	56.61	0
Kalimantan	w5	3878	26	0.00	0.21	39.73	0

Region	Equation	Obs	Parms	RMSE	"R-sq"	F	Prob > F
Kalimantan	w6	3878	26	0.01	0.09	15.43	0
Kalimantan	w7	3878	26	0.05	0.08	13.00	0
Kalimantan	w8	3878	26	0.01	0.30	64.56	0
Kalimantan	w9	3878	26	0.01	0.34	76.04	0
Kalimantan	w10	3878	26	0.01	0.22	41.26	0
Kalimantan	w11	3878	26	0.11	0.24	46.56	0
Kalimantan	w12	3878	26	0.10	0.13	21.68	0
Nusmapua	foodshare	40147	17	0.11	0.42	1676.65	0
Nusmapua	nfoodshare	40147	17	0.11	0.42	1676.65	0
Nusmapua	w1	961	27	0.04	0.51	36.43	0
Nusmapua	w2	961	27	0.04	0.25	11.59	0
Nusmapua	w3	961	27	0.02	0.05	1.79	0.0081
Nusmapua	w4	961	27	0.01	0.25	11.72	0
Nusmapua	w5	961	27	0.01	0.29	13.96	0
Nusmapua	w6	961	27	0.01	0.16	6.76	0
Nusmapua	w7	961	27	0.05	0.17	7.17	0
Nusmapua	w8	961	27	0.01	0.31	15.52	0
Nusmapua	w9	961	27	0.01	0.26	12.32	0
Nusmapua	w10	961	27	0.01	0.28	13.11	0
Nusmapua	w11	961	27	0.11	0.26	12.00	0
Nusmapua	w12	961	27	0.09	0.22	9.71	0
Sulawesi	foodshare	39290	17	0.11	0.33	1115.48	0
Sulawesi	nfoodshare	39290	17	0.11	0.33	1115.48	0
Sulawesi	w1	1388	27	0.03	0.52	54.54	0
Sulawesi	w2	1388	27	0.04	0.23	15.37	0
Sulawesi	w3	1388	27	0.01	0.09	5.01	0
Sulawesi	w4	1388	27	0.00	0.39	32.02	0
Sulawesi	w5	1388	27	0.00	0.23	15.22	0
Sulawesi	w6	1388	27	0.01	0.32	23.80	0
Sulawesi	w7	1388	27	0.05	0.12	6.62	0
Sulawesi	w8	1388	27	0.01	0.18	10.81	0
Sulawesi	w9	1388	27	0.01	0.29	20.46	0
Sulawesi	w10	1388	27	0.01	0.30	21.67	0
Sulawesi	w11	1388	27	0.11	0.31	22.33	0
Sulawesi	w12	1388	27	0.10	0.13	7.59	0
Sumatera	foodshare	84863	21	0.10	0.36	2280.97	0
Sumatera	nfoodshare	84863	21	0.10	0.36	2280.97	0
Sumatera	w1	9376	31	0.04	0.44	240.17	0
Sumatera	w2	9376	31	0.03	0.14	50.99	0
Sumatera	w3	9376	31	0.02	0.10	33.54	0
Sumatera	w4	9376	31	0.01	0.23	90.62	0

Region	Equation	Obs	Parms	RMSE	"R-sq"	F	Prob > F
Sumatera	w5	9376	31	0.00	0.23	90.60	0
Sumatera	w6	9376	31	0.02	0.18	65.12	0
Sumatera	w7	9376	31	0.05	0.19	69.63	0
Sumatera	w8	9376	31	0.01	0.28	115.48	0
Sumatera	w9	9376	31	0.01	0.29	122.08	0
Sumatera	w10	9376	31	0.01	0.23	87.49	0
Sumatera	w11	9376	31	0.10	0.19	72.46	0
Sumatera	w12	9376	31	0.10	0.14	49.84	0

Source: Author's calculation

Complete Estimation Coefficients

Complete estimation coefficients, data, and do file are available online at:

https://drive.google.com/drive/folders/193NOjjESgTmQHTjqCD_oApQ6zjppGfZn?usp=sharing

Appendix 4 – Elasticities

Estimated Elasticities Tables

Table 25 Estimated Expenditure Elasticities by Region

Class.	Region					
	Indonesia	Sumatera	Java-Bali	Kalimantan	Sulawesi	Nusmapua
	Conditional Elasticities					
Rice	0.369*	0.432*	0.356*	0.394*	0.354*	0.348*
	(0.005)	(0.009)	(0.007)	(0.016)	(0.024)	(0.033)
Meat	0.872*	0.851*	0.890*	0.783*	0.612*	0.851*
	(0.009)	(0.017)	(0.012)	(0.026)	(0.037)	(0.051)
Chicken egg	0.551*	0.603*	0.532*	0.463*	0.696*	0.933*
	(0.008)	(0.016)	(0.011)	(0.026)	(0.042)	(0.054)
Shallot	0.550*	0.503*	0.566*	0.454*	0.565*	0.583*
	(0.008)	(0.013)	(0.011)	(0.023)	(0.036)	(0.044)
Garlic	0.437*	0.469*	0.426*	0.420*	0.532*	0.569*
	(0.009)	(0.017)	(0.013)	(0.027)	(0.044)	(0.052)
Chili	0.712*	0.707*	0.710*	0.736*	0.544*	0.817*
	(0.009)	(0.014)	(0.013)	(0.034)	(0.05)	(0.049)
Fish	1.024*	1.067*	1.012*	1.063*	0.909*	0.950*
	(0.008)	(0.013)	(0.011)	(0.02)	(0.028)	(0.041)
Cooking oil	0.443*	0.477*	0.431*	0.415*	0.647*	0.492*
	(0.006)	(0.012)	(0.009)	(0.019)	(0.031)	(0.037)
White sugar	0.388*	0.461*	0.353*	0.345*	0.525*	0.429*
	(0.009)	(0.015)	(0.014)	(0.026)	(0.038)	(0.049)
Flour	0.379*	0.426*	0.359*	0.366*	0.361*	0.414*
	(0.01)	(0.017)	(0.014)	(0.029)	(0.046)	(0.057)
Processed food..	1.190*	1.137*	1.199*	1.155*	1.225*	1.106*
	(0.004)	(0.01)	(0.006)	(0.014)	(0.024)	(0.031)
Other food items	1.187*	1.260*	1.169*	1.219*	1.225*	1.280*
	(0.004)	(0.008)	(0.006)	(0.014)	(0.023)	(0.023)
	Unconditional Elasticities					
Food	0.815*	0.838*	0.795*	0.853*	0.878*	0.863*
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Non-Food	1.242*	1.221*	1.264*	1.179*	1.144*	1.208*
	(0.001)	(0.002)	(0.001)	(0.003)	(0.002)	(0.003)
Rice	0.301	0.362	0.283	0.336	0.311	0.300
Meat	0.711	0.713	0.708	0.668	0.537	0.734

Class.	Region					
	Indonesia	Sumatera	Java-Bali	Kalimantan	Sulawesi	Nusmapua
Chicken egg	0.449	0.505	0.423	0.395	0.611	0.805
Shallot	0.448	0.422	0.450	0.387	0.496	0.503
Garlic	0.356	0.393	0.339	0.358	0.467	0.491
Chili	0.580	0.592	0.564	0.628	0.478	0.705
Fish	0.835	0.894	0.805	0.907	0.798	0.820
Cooking oil	0.361	0.400	0.343	0.354	0.568	0.425
White sugar	0.316	0.386	0.281	0.294	0.461	0.370
Flour	0.309	0.357	0.285	0.312	0.317	0.357
Processed food..	0.970	0.953	0.953	0.985	1.076	0.954
Other food items	0.967	1.056	0.929	1.040	1.076	1.105

Notes: standard error in parentheses, * p<0.1, ‡ p<0.05, † p<0.01

Source: Author's calculation

Table 26 Uncompensated Own-Price Elasticities by Region

Class.	Region					
	Indonesia	Sumatera	Java-Bali	Kalimantan	Sulawesi	Nusmapua
	Conditional Elasticities					
Rice	-0.385*	-0.351*	-0.377*	-0.625*	-0.473*	0.090
	(0.019)	(0.042)	(0.025)	(0.061)	(0.086)	(0.124)
Meat	-0.356*	-0.286*	-0.348*	-0.631*	-0.628*	-0.382*
	(0.015)	(0.027)	(0.022)	(0.043)	(0.041)	(0.081)
Chicken egg	-0.699*	-0.817*	-0.651*	-0.785*	-0.916*	-0.785*
	(0.031)	(0.064)	(0.043)	(0.087)	(0.135)	(0.204)
Shallot	-0.702*	-0.718*	-0.696*	-0.523*	-0.857*	-0.932*
	(0.016)	(0.031)	(0.021)	(0.061)	(0.065)	(0.096)
Garlic	-0.722*	-0.615*	-0.744*	-0.715*	-1.173*	-1.085*
	(0.019)	(0.035)	(0.026)	(0.074)	(0.081)	(0.103)
Chili	-0.679*	-0.730*	-0.619*	-0.773*	-0.941*	-0.833*
	(0.014)	(0.033)	(0.02)	(0.047)	(0.062)	(0.069)

Class.	Region					
	Indonesia	Sumatera	Java-Bali	Kalimantan	Sulawesi	Nusmapua
Fish	-0.636*	-0.528*	-0.614*	-0.601*	-0.742*	-0.594*
	(0.009)	(0.026)	(0.013)	(0.048)	(0.054)	(0.057)
Cooking oil	-0.505*	-0.431*	-0.523*	-0.461*	-0.729*	-0.303*
	(0.024)	(0.05)	(0.032)	(0.077)	(0.111)	(0.138)
White sugar	-0.954*	-0.959*	-0.947*	-1.046*	-0.864*	-0.626*
	(0.011)	(0.019)	(0.015)	(0.04)	(0.103)	(0.155)
Flour	-0.743*	-0.794*	-0.748*	-0.601*	-0.404*	-0.692*
	(0.025)	(0.044)	(0.034)	(0.076)	(0.132)	(0.149)
Processed food..	-0.854*	-0.727*	-0.897*	-0.756*	-0.666*	-0.701*
	(0.008)	(0.017)	(0.011)	(0.026)	(0.041)	(0.058)
Other food items	-0.967*	-0.963*	-0.973*	-0.949*	-0.914*	-0.842*
	(0.004)	(0.008)	(0.006)	(0.015)	(0.023)	(0.028)
Unconditional Elasticities						
Food	-0.976*	-0.980*	-0.986*	-0.962*	-0.933*	-0.915*
	(0.002)	(0.003)	(0.003)	(0.005)	(0.005)	(0.003)
Non-Food	-0.940*	-0.947*	-0.946*	-0.911*	-0.932*	-0.906*
	(0.001)	(0.001)	(0.001)	(0.003)	(0.002)	(0.002)
Rice	-0.384	-0.350	-0.376	-0.624	-0.471	0.093
Meat	-0.355	-0.285	-0.347	-0.629	-0.625	-0.378
Chicken egg	-0.699	-0.817	-0.651	-0.785	-0.915	-0.783
Shallot	-0.702	-0.718	-0.696	-0.523	-0.857	-0.931
Garlic	-0.722	-0.615	-0.744	-0.715	-1.173	-1.085
Chili	-0.679	-0.730	-0.619	-0.773	-0.941	-0.832
Fish	-0.634	-0.526	-0.613	-0.596	-0.734	-0.586
Cooking oil	-0.505	-0.431	-0.523	-0.461	-0.728	-0.302
White sugar	-0.954	-0.959	-0.947	-1.046	-0.864	-0.626
Flour	-0.743	-0.794	-0.748	-0.601	-0.404	-0.692
Processed food..	-0.844	-0.721	-0.891	-0.741	-0.641	-0.675

Class.	Region					
	Indonesia	Sumatera	Java-Bali	Kalimantan	Sulawesi	Nusmapua
Other food items	-0.958	-0.955	-0.968	-0.935	-0.888	-0.805
Notes: standard error in parentheses, * p<0.1, ‡ p<0.05, † p<0.01						

Source: Author's calculation

Table 27 Compensated Own-Price Elasticities by Region

Class	Region					
	Indonesia	Sumatera	Java-Bali	Kalimantan	Sulawesi	Nusmapua
	Conditional Elasticities					
Rice	-0.346*	-0.302*	-0.339*	-0.587*	-0.437*	0.128
	(0.019)	(0.042)	(0.025)	(0.061)	(0.086)	(0.124)
Meat	-0.311*	-0.244*	-0.303*	-0.588*	-0.586*	-0.330*
	(0.015)	(0.027)	(0.022)	(0.043)	(0.04)	(0.08)
Chicken egg	-0.685*	-0.800*	-0.638*	-0.773*	-0.901*	-0.762*
	(0.031)	(0.064)	(0.043)	(0.087)	(0.135)	(0.204)
Shallot	-0.697*	-0.712*	-0.690*	-0.519*	-0.853*	-0.925*
	(0.016)	(0.031)	(0.021)	(0.061)	(0.065)	(0.096)
Garlic	-0.719*	-0.611*	-0.741*	-0.712*	-1.171*	-1.080*
	(0.019)	(0.035)	(0.026)	(0.074)	(0.081)	(0.103)
Chili	-0.665*	-0.708*	-0.607*	-0.763*	-0.935*	-0.818*
	(0.014)	(0.033)	(0.02)	(0.047)	(0.062)	(0.069)
Fish	-0.555*	-0.418*	-0.544*	-0.479*	-0.629*	-0.497*
	(0.009)	(0.025)	(0.013)	(0.048)	(0.054)	(0.056)
Cooking oil	-0.495*	-0.420*	-0.514*	-0.452*	-0.716*	-0.293*
	(0.024)	(0.05)	(0.032)	(0.077)	(0.11)	(0.138)
White sugar	-0.949*	-0.951*	-0.943*	-1.041*	-0.857*	-0.621*
	(0.011)	(0.019)	(0.015)	(0.04)	(0.103)	(0.155)
Flour	-0.740*	-0.790*	-0.746*	-0.598*	-0.400*	-0.688*
	(0.025)	(0.044)	(0.034)	(0.076)	(0.132)	(0.149)
Processed food..	-0.455*	-0.415*	-0.475*	-0.374*	-0.289*	-0.392*
	(0.008)	(0.017)	(0.011)	(0.026)	(0.041)	(0.057)
Other food items	-0.587*	-0.549*	-0.599*	-0.580*	-0.531*	-0.409*
	(0.005)	(0.008)	(0.006)	(0.015)	(0.024)	(0.029)
	Unconditional Elasticities					
Food	-0.515*	-0.497*	-0.538*	-0.493*	-0.458*	-0.395*
	(0.002)	(0.003)	(0.003)	(0.005)	(0.005)	(0.004)
Non-Food	-0.402*	-0.430*	-0.394*	-0.380*	-0.407*	-0.426*
	(0.001)	(0.002)	(0.001)	(0.003)	(0.002)	(0.002)
Rice	-0.366	-0.326	-0.359	-0.605	-0.453	0.113

Class	Region					
	Indonesia	Sumatera	Java-Bali	Kalimantan	Sulawesi	Nusmapua
Meat	-0.334	-0.265	-0.327	-0.609	-0.605	-0.351
Chicken egg	-0.692	-0.808	-0.645	-0.779	-0.908	-0.771
Shallot	-0.700	-0.715	-0.693	-0.521	-0.855	-0.928
Garlic	-0.721	-0.613	-0.743	-0.714	-1.172	-1.082
Chili	-0.672	-0.719	-0.613	-0.768	-0.938	-0.824
Fish	-0.597	-0.473	-0.582	-0.539	-0.681	-0.535
Cooking oil	-0.500	-0.426	-0.519	-0.456	-0.722	-0.297
White sugar	-0.952	-0.955	-0.945	-1.044	-0.860	-0.623
Flour	-0.742	-0.792	-0.747	-0.599	-0.401	-0.689
Processed food…	-0.660	-0.570	-0.702	-0.562	-0.461	-0.514
Other food items	-0.783	-0.755	-0.800	-0.761	-0.706	-0.580

Notes: standard error in parentheses, * p<0.1, ‡ p<0.05, † p<0.01

Source: Author's calculation

Appendix 5 – Estimated Quantity Changed During Price Increase Events

Table 28 Quantity Change Results Based on Scenario I

Commodity	Quantity Change - Jan 2022 (5)					
	Indonesia	Sumatera	Java-Bali	Kalimantan	Sulawesi	Nusmapua
Rice	-5.4%	-4.4%	-1.5%	22.6%	1.0%	7.2%
Meat	-1.7%	-2.1%	0.6%	-9.0%	-4.3%	-7.1%
Chicken egg	4.2%	-0.3%	12.2%	4.8%	-5.4%	8.5%
Shallot	6.7%	5.8%	6.7%	5.1%	5.5%	8.5%
Garlic	1.3%	-0.4%	5.8%	2.4%	-0.6%	7.2%
Chili	0.5%	14.8%	10.6%	-10.5%	-5.9%	-16.8%
Fish	0.8%	1.1%	-1.3%	-5.1%	1.5%	8.8%
Cooking oil	-19.7%	-13.2%	-25.2%	-11.5%	-25.0%	-9.4%
White sugar	-4.1%	-5.1%	-5.3%	-5.6%	-1.6%	0.2%
Flour	-1.9%	-3.3%	-1.3%	1.0%	2.1%	-0.9%
Processed food	4.0%	-1.2%	-6.2%	9.6%	2.4%	0.0%
Other food items	4.4%	2.1%	-3.1%	10.0%	4.6%	7.0%

Source: Author's calculation

Table 29 Quantity Change Results Based on Scenario II

Commodity	Quantity Change - Mei 2019 (IV)					
	Indonesia	Sumatera	Java-Bali	Kalimantan	Sulawesi	Nusmapua
Rice	3.7%	-8.0%	0.2%	15.0%	38.2%	-28.8%
Meat	0.8%	2.8%	-0.9%	6.5%	-0.1%	4.5%
Chicken egg	0.4%	-4.7%	1.8%	20.2%	-29.5%	2.2%
Shallot	-12.3%	-13.5%	-8.5%	-6.4%	2.4%	-20.1%
Garlic	-32.5%	-22.4%	-24.6%	-30.1%	-56.9%	-56.4%
Chili	-8.2%	-19.3%	-8.6%	-16.0%	-7.9%	-0.3%
Fish	4.2%	2.5%	2.9%	-6.2%	-16.2%	16.3%
Cooking oil	8.8%	15.8%	5.8%	20.7%	-17.5%	-6.1%
White sugar	0.5%	1.2%	-2.9%	-4.9%	-6.2%	33.3%
Flour	0.9%	4.8%	-0.7%	5.1%	28.5%	8.5%
Processed food	21.8%	7.9%	21.4%	12.0%	17.1%	-2.9%
Other food items	14.8%	10.9%	12.8%	11.7%	23.7%	10.2%

Source: Author's calculation

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