Consumer Responses to Price Shocks of Wine Imports in Korea

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The main purpose of the study is to develop a methodology that divides consumers' responses to free trade agreements (FTAs) or commodity taxes into quantitative and qualitative margins, which cause exogenous price changes for certain specific goods. Unlike the usual method of using unit values as a proxy variable for market prices, the use of unit values as a dependent variable for consumers' qualitative choice showed that qualitative responses to price changes exist, and their size is significant. The methodology of separating and estimating qualitative responses to income changes as in economic crises revealed that many of the existing income effects are qualitative responses. As a key result, the price elasticity of −1.178 estimated by the usual demand model based on a single commodity assumption was reduced to −0.712 for the quantitative margin only, and the qualitative margin was the remaining −0.466, which accounted for more than a third of the overall response. The significant degree of qualitative response estimates suggests that policy makers and researchers should consider qualitative response as an important factor when analyzing the effectiveness of FTAs, especially in consumption.

Keywords: FTA; commodity tax; price elasticity of wine consumption; quality choice; unit value; quality-adjusted price

JEL Classification: D11; D12; F14

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I. Introduction

The proliferation of free trade agreements (FTAs) in the last three decades has contributed to globalization, and many participant countries have benefited from expanded trade due to reduced prices and increased variety. Efficiency gains from trade on the supply side have been emphasized and studied more than consumer welfare improvement stemming from price effects and varieties. However, recently, the demand side has elicited much attention from the academia and policy circles partly because of the development of new trade theory and increased interests in the extensive margin.

This study investigates empirically how the external shocks of exogenous price changes due to trade policies, such as FTAs, affect the consumption patterns of imported products, such as wine, in South Korea (Korea henceforth). Notably, wine is an almost totally imported product in Korea and rarely produced domestically. For this reason, wine provides an advantage for the purpose of this study. Tariff reduction through FTAs directly affects the import prices of wine and potentially lowers retail prices without complications in the Korean wine market because we do not have to consider the effects of FTAs on domestic production or exports, which might have implications for retail prices if domestic substitutes are available. Therefore, the price changes of wine can be regarded as purely exogenous in the Korean market.

In the past, only a few Koreans enjoyed wine consumption. It was only in 1988 when Korea hosted the Seoul 1988 Summer Olympics that import restrictions on wine were lifted. Since then, wine imports have increased by 68 times in Korea from 3.8 million US dollars in 1988 to 259 million US dollars in 2019. Many elements could have contributed to this skyrocketing increase in wine imports and consumption in Korea. For instance, Korea's FTAs with wine-producing countries, such as Chile, the United States, Europe (including France, Italy, and Spain), Australia, and New Zealand, must have played a crucial role.

Chile was Korea's first FTA partner, and the Korea–Chile FTA came into effect in 2004, which was when Chilean wine was introduced to Korean consumers. However, the retail price of wine did not decrease much until Korea entered into FTAs with other countries, such as the US and Europe, and many Korean wine lovers complained about it. Wine prices in Korea started to decline sharply only when competition became severe in the Korean market among Korean wine importers from various exporting countries that had entered into FTAs with Korea.

Wine consumption skyrocketed in Korea as wine became available at much lower prices than before and in many stores. This price effect expanded the consumer base. People who had never tasted wine before and sporadic consumers could become regular buyers of various cheap wine products imported from all over the world. Furthermore, those who had already enjoyed wine could consume more because of the income effect and the extensive variety available. Korean wine consumption, through many FTAs with wine-producing countries, increased because of the extensive margin of numerous varieties and new consumers and the intensive margin. Meanwhile, the increased wine consumption brought about economies of scale when importing wine and further lowered the import price on top of tariff reduction.

Although this empirical study analyzes wine consumption with regard to price and income changes, the main purpose of the study is to develop a methodology that divides consumers' responses to pricing policies, such as FTAs or commodity taxes, into quantitative and qualitative margins, which cause exogenous price changes for specific goods. Through an empirical analysis, we discuss how different policy implications are derived from existing policy evaluations that consider quantitative margins only.

In the analysis of the impact of price changes on the consumption of specific items, such as wine, due to FTAs, the key task is the estimation of demand price elasticity. The role of estimated price elasticity is the same as that in the study of pricing policy evaluations represented by commodity taxes. Discussions of prior research on fiscal policies aimed at improving health would be helpful for revealing the significance of the explicit consideration of qualitative margins in price elasticity estimation tasks. Many countries, including Korea, have been actively discussing policy tools that achieve public health promotion and fiscal expansion through certain commodity taxes, such as tobacco and soda taxes. For example, soda tax as an obesity tax has been actively

discussed in many countries, including the United States, Mexico, and New Zealand, as a health policy that can effectively reduce the incidence of obesity-related diseases. The path to the effectiveness of related policies is that the consumption of goods responds elastically to exogenous price changes at the first stage, and reduced consumption of goods improves key health indicators, such as obesity degree, at the next stage. The link that economists are mainly involved with is the estimation of the price elasticity of the demand for goods by utilizing individual data such as household surveys or time series macro data. Naturally, the main rationale behind the introduction of soda tax is relatively high demand price elasticity estimates (Grogger, 2017).

However, several recent studies on the subject have pointed out that these empirical studies, which were the main basis for the introduced fiscal policy, did not properly analyze the patterns of consumer behavior (Andalón and Gibson, 2017). Specifically, the commodity unit, such as sugar-sweetened beverage or tobacco in most empirical analyses, was an aggregated one that included different quality varieties, and the standard methodology of demand analysis did not distinguish the response according to the qualitative margin. In other words, the estimated significant price elasticity can reflect the reduction of individual consumption on one hand and the replacement of low-quality goods due to tax increases on the other hand, which overestimates the expected health benefits of certain commodity taxes. Furthermore, the significant qualitative replacement of low-quality goods could have a negative effect on health because low-quality goods, such as low-quality cigarettes without filters, are more harmful than high-quality ones. In this case, the final goal of the health policy, such as lung cancer incidence, may depend on the portion of the effect of low-quality consumption. Thus, the adequacy of existing research on consumption and welfare changes needs to be examined through explicit consideration of consumers' behavior in quantitative and qualitative margins in response to exogenous commodity price changes (*e.g.*, tobacco tax).

This issue is not limited to the problem of broadly classified goods, such as food and beverage products. It also frequently occurs in the analysis of commodities classified into very detailed units to the extent that they are assumed to be a single commodity. For example, specific goods, such as rice and wine, also have substantial quality diversity. The usual methodology for estimating demand price elasticity is to

regard wine as a single commodity, but the import price per 750 ml bottle announced in August 2020 is about 3000 times the price of the lowest-quality French wine, and the average price of the 1st quartile (top 25%) of import wine was 9 times the average price of the 2nd quartile. These qualitative differences enable consumers to respond to exogenous price changes in qualitative margins as substantially as they respond to quantitative margins.[1] The high (low) quality covered in this study is represented by a high (low) price per unit of quantity. In the case of cigarettes and soda, which are subject to fiscal and health policies, low-quality products are likely to be unhealthy compared with high-quality products. However, when the price is determined by other factors, such as color or refining degree (*e.g.*, in rice), the price as a proxy of quality can be irrelevant to health, and in several cases, low-quality products can even be healthier than high-price products.

II. Literature Review

A. Research on the Effects of FTAs and Consumption in Korea

Trade liberalization policies, such as FTAs, are believed to bring benefits to consumers because FTAs allow consumers to have better access to a larger number and a wider variety of products at lower prices due to tariff elimination or reduction compared with a closed economy without FTAs. However, this is not always the case because reductions in tariff and import prices do not automatically lower the retail price when FTAs do not bring about a competitive market environment. Suh *et al.* (2013) documented this situation by investigating Korea's trade liberalization policies and the relationship between import and retail prices. Although Korea's weighted average tariff declined to 5.1 percent in 2011 from 11.3 percent in 1995, contributing to the reduction of import prices, retail prices did not

[1] Another important example is tobacco in Korea, which was a main commodity in prior research on consumer qualitative alternatives. Currently, cigarette price per pack, which is 4500 Korean won (about 4 US dollars), is also a kind of representative price based on the most popular price category. The price of cigarettes differed from 1900 won to 5000 won before the price increase in 2015, and even after the price increase, it was sold in the price range of 3500–6000 won. In 2018, cigarettes priced at 10,000 won were introduced to the market.

decline. To explain this occurrence, two factors were pointed out in the study. First, the conventional price index understated the rate of decline in import prices by 20 percent from 1992 to 2011. When the price index was appropriately calculated, Suh *et al.* (2013) found out that the variety-adjusted price index decreased by about 20 percent faster than the conventional price index during the period. Second, the domestic retail price did not decline despite the reduction of tariffs due to price deteriorations in the process of domestic marketing for imported consumer goods. According to Suh *et al.* (2013), most of the imported manufactured goods in this period, particularly small household appliances, were supplied by only one overseas affiliate who virtually had monopoly power in the Korean market. Moreover, the marketing margin of imported goods was two or three times higher than that of domestic products. Their research concluded that fair competition is one of the most effective ways to reduce the marketing costs, including the marketing margin, of imported goods.

Related studies on the effects of Korea's FTAs and their tariff reduction on prices and consumer welfare have also been conducted, but most of them did not consider qualitative replacement. For example, Jeong (2015) examined the effects of the Korea–Chile FTA on the import prices of agricultural products within the period of 2004 to 2013. The study found that the FTA did not lead to a domestic price decline in imported agricultural products mainly because of the monopoly power of Chilean exporters in the Korean market. Other factors, such as Korea's small market size for such products, import structure, and distribution and marketing channels, were also identified as possible reasons. Kwark and Lim (2018) conducted a counterfactual analysis to investigate the effects of FTAs on the domestic consumer price index (CPI) in Korea. They constructed "but-for-price," which is a hypothetically weighted price index without FTAs, and found that FTAs reduced the CPI inflation rate by 0.76 percent point at an annual basis compared with the actual CPI for the period of 2004 and 2015. Lee *et al.* (2013) investigated why FTAs did not reduce the prices of agricultural products in Korea as originally expected. They listed irrational import structure and inefficient distribution process as possible reasons. According to Lee *et al.* (2013), practical market dominance, increased markup of exports, and distribution margins at wholesale and retail stages are the principal reasons why the domestic prices of agricultural products imported from FTA partner countries did not decrease as

much as the reduced tariff.

Another line of research on FTA effects considered the quality of imported products. Lee (2013) used survey data on Korean consumers' purchase experiences of goods imported from FTA partner countries. The empirical results suggested that product service, quality, brand and design, and practicality are important factors to consumers, whereas price, accessibility, and convenience are not significant factors in purchase decisions. The study reported that quality replacement can be an important factor but did not provide a methodological approach for its estimation. Hwang and Lee (2016) examined the effects of the Korea–Chile FTA on wine imports. They used time series data from 2000 to 2015 and found that a long-running equilibrium relationship exists between the volume of wine imports and several determinant variables, such as income and price. The Korea Consumer Agency (KCA) (2019) provides useful survey information on how Korean consumers assess their purchase experience of imported products after Korea implemented a few FTAs. Notably, many Korean consumers recently perceive that import prices have declined. In 2019, 66.6 percent indicated that the import price of consumer goods declined, whereas the figure was 32.7 percent in 2015 and 42.8 percent in 2016. As for imported wine, consumers stated that variety has increased (85.7 percent of consumers), price has decreased (54.7 percent), and quality has improved (78 percent). The survey results suggested that many of the deteriorating factors, such as competition problem due to monopoly power, distribution channels, and marketing margins, that have blocked the price reduction of imported products might have been corrected or eliminated in the Korean market.

B. Research on Demand Analysis

The majority of research on the elasticity of demand for goods subject to commodity taxes has used household survey data because various policy effects can be verified by certain household characteristics, such as income levels, in the data. In addition, household survey data are useful for deriving the unit value of each commodity, which is the key variable of demand analysis. We can utilize this unit value derived from household survey data as price proxy, which is calculated by dividing the expenditure of a certain product by the consumption quantity of the product. This idea was developed so that research on demand analysis

can be conducted with only unit value variables without having to collect independent regional price variables separately from household surveys (Prais and Houthaker, 1955).

However, the unit value of aggregates reflects the choice of qualitative composition within the product aggregates in addition to price levels; hence, demand analysis using them requires additional work to exclude qualitative choices from the unit value. Literature conducted over the past 30 years has tackled this issue in two ways. The first method of separating qualitative choices from the unit value was developed in the field of agricultural economics, which mainly targets the analysis of demand for food products. This approach does not consider qualitative and quantitative choices simultaneously but rather sequentially, and it modifies unit values to ordinary price variables by removing qualitative choices from them. The original form of this method was developed by Cox and Wohlgenant (1986), who proposed a method of eliminating the effects of quality choices by regressing unit values to household characteristics, such as income levels, that could affect quality choices. Given the simplicity of this method, numerous studies have used it in many applied fields. Park and Capps (1997) applied the method to analyze the demand for food products, and Fleischer and Rivlin (2009) expanded its use to empirical analysis in tourism.

The sophisticated price proxy variables that eliminated the effect of these qualitative choices on unit values are called "quality-adjusted prices." The standard form includes the self-selection control variable in the sense that the consumption of households is selective in certain goods, such as pasta (Dong *et al.*, 1998). This methodology associated with the use of unit value variables is also important in the field of international trade, which is the subject of this study, because most commodity units are aggregates, and their unit values are recognized and utilized as ordinary price variables (Kim *et al.*, 2015). Although this methodology is intuitive and easy to apply, it is based on a less well-known crucial assumption regarding consumers' behavior. Consumers are assumed to have a predetermined choice about a particular brand or the quality of their consumption product. For example, high-income households make prior choices about a particular wine brand of high quality, and these consumers respond to unexpected price changes with quantitative adjustments instead of changing the brand or quality. In other words, the assumption is that at the first stage, the choice of a brand of a particular quality among aggregates is made; then, the

quantitative choice of that brand is made for the given price level at the second stage. The hypothesis about this pre-committed behavior of consumers may be questionable and needs to be verified. In this study, we conduct a direct test on this hypothesis.

The second approach (Deaton, 1988) is to consider quantitative and qualitative margins of consumer behavior simultaneously, thus allowing for qualitative response to price changes, but with strong theoretical assumptions to overcome the limitation that ordinary household surveys do not have independent local market price variables.[2] However, the separability assumption, which is the core of Deaton's methodology, was largely denied in recent empirical studies, in which abundant complete data with independent price variables, such as regional market prices, are available (McKelvy, 2011).[3] Gibson and Kim (2013) adopted a sophisticated approach of McKelvy's to describe the Vietnamese government's ban on rice exports that tripled the international price of rice in 2007. The Vietnamese government's intervention in the rice market aimed to prevent consumer damage caused by a lack of domestic supply, and the intervention was mainly based on previous studies (Gibson and Rozelle, 2005) that showed significant rice price elasticity in Vietnam. Gibson and Kim (2013) revealed that the price elasticity of rice is significantly overstated because it does not consider consumers' strategy to replace expensive rice with low-quality and less expensive rice. The study pointed out that several trade regulations, such as rice bans, could have an incorrect basis if consumers do not properly consider the problem of choosing quality. It also mentioned that the results of empirical studies based on overstated price elasticities may affect other domestic policies, such as restrictions on the use of rice-producing farmland in the long run, and create externalities, such as greatly amplifying price volatility in the

[2] An alternative analytical model for quality choice is the demand model for product space (Berry *et al.*, 1995), which views the product as a variety of physical feature bundles (notebooks with different memory, screen sizes, *etc.*). Unlike Deaton's approach, household survey data containing only expenditure information on considerable aggregates are used as the main analysis data, the alternative one uses data on the supply side, such as firm-level data.

[3] The approach using independent price variables used by this work is further justified and differentiated from Deaton's approach due to recent empirical analysis results (Gibson and Kim, 2015) on a number of goods with varying quality dimensions for separable preferences adopted by Deaton.

international rice market.

The empirical methodology that considers consumer behavior on quantitative and qualitative margins simultaneously can be used for studies on cigarette taxes, which can provide accurate information for establishing health and fiscal policies. Chaloupka *et al.* (2010) reported that taxing a pack of cigarettes could lower the relative price of high-quality cigarettes, resulting in a qualitative replacement toward high-quality cigarettes. Thus, the specific tax can be better for people's health than the ad valorem tax. Saenz de Miera Juarez *et al.* (2014) found substantial differences in consumer behavior in quality composition depending on the taxation method by investigating the case of Mexico's tobacco taxation method converted from ad valorem tax to specific tax in 2011. Gibson and Kim (2019) partly adopted the methodology of this study and explicitly distinguished qualitative and quantitative price elasticity by using Papua New Guinea household survey micro-data. They reported a significant qualitative downward response in tobacco consumption to price increases.

Meanwhile, consumers' qualitative responses to exogenous price changes may be regarded as part of consumers' strategies to handle external income shocks caused by economic crises. McKenzie *et al.* (2011) analyzed purchasing activities to find cheaper prices than usual in response to external negative shocks.[4] Chen and Juvenal (2018) documented the consumer behavior of responding to income reductions due to external shocks during the global financial crisis in 2008 by showing the increased consumption of cheap-quality wines without reducing the quantity of wine consumption.

The following chapter describes a methodology that explicitly considers qualitative responses to price or income changes to analyze the impact of exogenous price changes on consumption. In this study, we use an improved model that adds price variables to an estimation

[4] A consumer strategy that attempts to change the purchase price can include the study of bulk discounting by Gibson and Kim (2018). It examines the hypothesis that the utilization of the strategy may depend on household income because the use of the strategy of bulk purchasing, which lowers the unit price, depends on the constraint of storage or liquidity. The part of the study on the association between consumption behavior and household income may be linked to the analysis of the income distribution of new consumers participating in consumption as wine prices change.

model (Deaton, 1988), that is, unit value equations representing quality choice are incorporated into the standard AIDS model of quantity demand. Our model explicitly shows that the conventional estimation model with only quantitative margins overstates the price elasticity of quantity demand when consumers' responses to qualitative margins are not properly considered. We present a model to estimate the demand elasticity of wine by dividing it into three ways: quantitative (intensive) and qualitative (replacement toward low-cost wine or extensive) margins and an additional extensive margin for deciding whether to consume wine in response to wine price changes.

III. Methodology

The literature on empirical analyses that estimate price elasticity can be broadly classified into studies using individual data, such as household survey data, and those using time series data by country with representative individuals as analysis units. The use of household survey data has the advantage of utilizing household, personal, and regional characteristics (*e.g.*, household income levels), and the use of time-series data has the advantage of considering the short- and long-term effects of addictive goods, such as cigarettes and wine (Selvaraj *et al.*, 2015; Zhen *et al.,* 2010). Most existing studies that explicitly considered consumers' qualitative response in the analysis of price elasticity of aggregates, which is also the central theme of this study, adopted the analysis of regional price differences and consumer behavior in household or individual units. Price elasticity estimation considering qualitative responses can also adopt the analysis of time series data. By linking price elasticity with two different data sets, the estimated price elasticity using household consumption and regional price differences is interpreted as long-term elasticity for time series data because regional price differences stem from long-term regional supply costs. The following text illustrates the qualitative response problem in demand analysis with an empirical model for time series data.

To estimate the price elasticity of demand, we use a linear AIDS model with the wine consumption C_t of a representative individual as a dependent variable. The explanatory variables include lnx_t, which is log GDI per capita at time t, lnP_t, which is log market price at time t, and other controlled variables z_t, which contain t and t^2 indicating nonlinear

trends in consumption, adult population, and lagged consumption C_{t-1}, which indicates the addictive property of wine consumption. u_t^1 represents a random error.

$$C_t = \alpha^1 + \beta^1 lnx_t + \theta lnP_t + \gamma' z_t + u_t^1 \quad (1)$$

A typical empirical model assumes that wine is considered a single commodity, and wine consumption C_t represents the product of scalar price (P_t) and scalar quantity (Q_t). The estimated coefficient θ and average wine output ($\bar{C}$) over the data period are utilized accordingly to calculate the price elasticity formula $\varepsilon_P \equiv \partial lnQ_t / \partial lnP_t = \theta / \bar{C} - 1$. However, in this study, price elasticity is calculated by explicitly considering that the wine product is a collection of different quality varieties. The consumption (C_t) of wine as an aggregate expenditure refers to the product of a price vector (P_t) and a quantity vector of a different quality variety (q_t). Thus, wine consumption (C_t) can be expressed as the product of the two scalar variables, namely, $C_t = \upsilon_t Q_t$. Of the two scalar variables, Q_t represents the quantitative choice of wine consumption as the number of 750 ml wine bottles regardless of quality, and unit value υ_t contains qualitative choice information that represents various brands of different quality. For example, if two different quality varieties of wine exist and both are priced higher by 10%, the unit value will increase below 10% if consumers respond to the price increase by downgrading their consumption quality, that is, by increasing the composition ratio of the low-quality variety. Considering consumers' qualitative choices for these price changes, we can accurately estimate the changes in wine consumption (positive) by separating consumers' quantitative and qualitative responses to exogenous price changes due to external shocks, such as FTAs.

To explicitly reflect consumers' qualitative choice in response to price and income changes, we specify Equation (2) with unit value as a dependent variable.[5]

$$ln\upsilon_t = \alpha^2 + \beta^2 lnx_t + \varphi lnP_t + \gamma' z_t + u_t^2 \quad (2)$$

[5] The models of Equations (1) and (2) on consumers' qualitative responses to price changes follow Deaton's (1990) seminal study on the subject. A more detailed description of relevant consumer theories can be found in Deaton's paper (1997).

Equation (2) has the same coefficient notation as Equation (1) (defined differently by the superscript though) except for the coefficient of the log price variable, which is denoted by φ to highlight the quality response to price changes. The usual price elasticity formula ($\varepsilon_P = \theta/\bar{C} - 1$) described above is obtained by partial differentiation of the expenditure to lnP_t, which is limited to the consideration of wine as a single good.[6] Given that wine is an aggregate in which the total consumption is $v_t\theta_t$, the price elasticity formula that reflects the qualitative response to price changes should be modified as ($\varepsilon_P = \theta/\bar{C} - \varphi$). In other words, the usual price elasticity $\varepsilon_P = \theta/\bar{C} - 1$ can be separated by the sum of ($\theta/\bar{C} - \varphi$) and ($\varphi - 1$), with the former being defined as the accurate price elasticity of quantitative demand and the latter as the price elasticity of qualitative demand. If the unit value changes proportionately without changing the quality composition of wine in response to changes in price ($\varphi = 1$), the qualitative demand price elasticity will be zero. The price elasticity formula that considers qualitative responses will be similar to the usual formula with a single commodity assumption. By the same token, the income elasticity of wine (quantitative) demand, excluding qualitative responses, can be modified as ($\beta^1/\bar{C} - \beta^2$) rather than ($\varepsilon_x = \beta^1/\bar{C}$). Here, the value of coefficient β^2 represents the elasticity of unit value with respect to income.

The increase in wine consumption induced by price cuts can be divided into quantity increases, composition changes toward high-quality wine varieties, and increased number of wine consumers who newly entered the wine market. The methods of estimating changes in consumption rates only in response to price changes include a logit model for individual consumption data and a linear probability model for time series data. In this study, we modify the existing model to include the simultaneous consideration of whether changes in wine consumption are based quantity or quality adjustment in response to price changes.

The expected value of wine consumption in Equation (1), $E(C_t)$, is expressed as the product of the expected value of the consumer's conditional consumption $E(C_t | C_t > 0)$ and the probability of positive

[6] Wine consumption values used in price elasticity or income elasticity estimation formulas adopt the average value of consumption as in other studies, but other observations from consumption distribution (*e.g.*, top 25%) allow policy effects on different consumption levels.

consumption $Pr(C_t > 0)$. This means that the usual price elasticity partly represents a change in consumption, and in the rest, the consumption rate price elasticity represents whether it is consumed or not. These consumer responses are called changes in the consumption of existing consumers and changes in the extensive margins of new consumers. Considering the concept of quantitative and qualitative price elasticity obtained by adding Equation (2) to such changes, the usual unconditional price elasticity ($\varepsilon_P = \theta / \bar{C} - 1$) can be expressed as the sum of three elasticities: conditional quantitative price elasticity, conditional qualitative price elasticity, and consumption rate price elasticity. To directly estimate the consumption rate price elasticity, we specify Equation (3), where the dependent variable π_t is the consumption rate of a representative consumer.

$$\pi_t = \alpha^3 + \beta^3 lnx_t + \delta lnP_t + \gamma' z_t + u_t^3 \tag{3}$$

To combine the three elasticity estimation processes, the unconditional consumption expenditure C_t in Equation (1) is modified to conditional consumption C_t^*, which is C_t/π_t, and we estimate them with Equations (2) and (3) by using the seemingly unrelated regression estimation model. The first part of Equation (4) denotes the price elasticity of conditional quantitative demand, the second part denotes the price elasticity of conditional qualitative demand, and the third part denotes the consumption rate price elasticity.

$$\varepsilon_P = \left(\frac{\theta}{\bar{C}^*} - 1 \right) + \left(\frac{\delta}{\bar{\pi}} \right) = \left(\frac{\theta}{\bar{C}^*} - \varphi \right) + (\varphi - 1) + \left(\frac{\delta}{\bar{\pi}} \right) \tag{4}$$

We introduce a methodology of quality-adjusted price with a different approach to qualitative factors in demand analysis and underscore the problem of a conventional methodology using unit values compared with the methodology we use in this study. A brief description of the derivation of the quality-adjusted prices begins with Equation (5), which was transformed from Equation (2).

$$lnv_t = (\alpha^2 + \beta^2 lnx_t + \gamma' z_t) + (\varphi lnP_t + u_t^2) \tag{5}$$

Equation (5) separates the unit value into one part affected by individual characteristics, such as income, and another part affected by price variables and random errors. The next step is to create a quality-

adjusted price by removing the predicted value of the first part from the unit value on the left-hand side of Equation (5) and leaving the second part controlled by the time-fixed effect model. This process is expressed in Equation (6)[7].

$$\widehat{lnP_t} = lnv_t - (\widehat{\alpha^2} + \widehat{\beta^2} lnx_t + \widehat{\gamma'}\ z_t) = (\varphi lnP_t + u_t^2) \tag{6}$$

Among the right-hand deliverables of Equation (6), unobservable u_t^2 is not a problem because it can be interpreted as a supply-side random impact. We can see that the market price variable is multiplied by parameter φ indicating whether the consumer responds to price changes. Quality-adjusted price methods that follow the Cox and Wohlgenant approach set the coefficient value of the log price to 1 ($\varphi = 1$) assuming that the choice of the brand/quality is preceded by the assumption of consumption behavior as previously described. For this, a direct hypothesis test is possible if an independent market price variable is present. If a qualitative downward response towards a high price level exists, then the quality-adjusted price derived from Equation (6) is replaced by the price variable in Equation (1), and the price elasticity formula is modified to $\varepsilon_P = (\theta/\varphi)/\bar{C} - 1$, where θ denotes the consumption response to the price. It may have an inflating effect because the quality response parameter is less than one and θ/φ with $0 < \varphi < 1$. In addition, this methodology, which uses ordinary self-selecting variables, distinguishes conditional and unconditional demands in relation to the methodology in this study (Dong *et al.*, 1998). If unconditional demand is the primary analytical target, the Heckman approach may not be appropriate when Equation (1) is used.

IV. Empirical Analysis

A. Data

[7] In this process, variables, such as Heckman's inverse density rate, which solves the problem of self-selection, may be added when using household unit value variables in household surveys and for goods consumed only by limited households.

This study uses monthly time series data on the wine imports of Korea, import prices, and unit values as key variables for estimating demand elasticity. Import prices are obtained from KCA, and wine imports and other control variables, such as gross adult population and gross national income per capita, are obtained from Statistics Korea. The summarized statistics of the variables are shown in Appendix Table 1.[8]

In this study, the core work is to estimate consumers' qualitative response and demand price elasticity, and the unit value is the key variable in the process. The unit value includes the level of market price, but it is distinct from the market price reflecting consumers' quality choices. Quality choices are naturally expected to be significantly correlated with income levels. Here, we describe the characteristics of unit values intuitively by using graphs. First, for the fundamental reason that unit values should not be used as price variables, Figure 1 shows that unit values have an apparent positive relationship with income levels unlike ordinary market prices that are independent of income levels. This relationship indicates that unit values should not be used as a proxy for market price variables in demand analysis and that it is indispensable to adopt quality-adjusted price methods. To eliminate the trends of time-series data and solve problems in other units of measure, unit values and income levels are log-transformed and standardized in Figure 1. The tight upward trend of unit values to income in Figure 1 indicates that the relationship is statistically significant.

Figure 2 illustrates the existence of responses that partially reduce

[8] Expenditure and unit value variables, which are dependent variables in Equations (1) and (2), are monthly observations for 31 years from 1988 to 2018. Among them, 33 are monthly observations (April 2016 to December 2018) of import price data by country made from a simple average of individual brands provided by the Korea Consumer Agency. The empirical analysis using the import price variables in Figure 2 and Table 1 (Columns (1) and (2)) is the analysis using these 33 observations. The quality-adjusted price method (Column (3) of Table 1), which does not use market price variables, utilizes 31 annual data that fully utilize the time series variability of wine expenditure and wine unit value. The calculation of income elasticity presented in empirical analysis also uses annual data to fully utilize the time series variability of national income variables. The period of monthly data is considerably short, and several annual explanatory variables are included. Thus, the seasonal effects are not controlled.

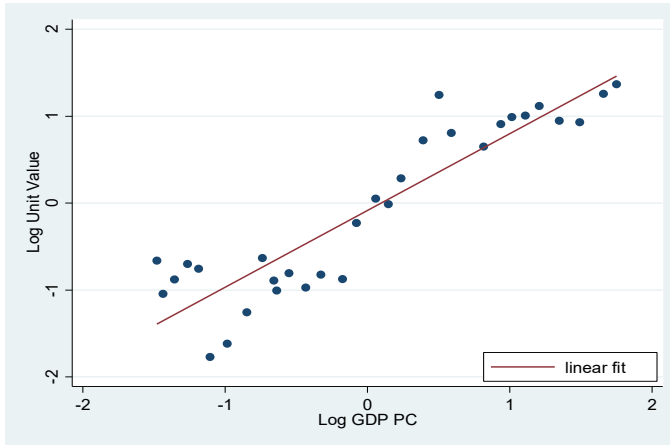

FIGURE 1
RELATIONSHIP BETWEEN UNIT VALUES AND INCOME LEVELS

consumption quantity and simultaneously increase the proportion of consumption of low-quality goods as price increases. This is a key feature in this study. The slope of the linear relationship between the log-transformed unit values and the log-transformed market prices represents the value of φ in Equation (2). To clearly illustrate consumers' qualitative responses to an increase in price, we add a 45° line called $\varphi = 1$, which indicates no quality shading in response to price changes. The 45° gradient also reflects a key assumption of consumer behavior in the quality-adjusted price method. The estimated linear relationship between the two variables shows a qualitative downward response of consumers to an increase in price, and the estimated slope statistically significantly rejects the $\varphi = 1$ hypothesis.

Figure 3 shows the trends of wine imports and their quantities. Wine imports and quantities were on a steady rise, temporarily decreased during the Asian financial crisis of 1997 and the 2008 global financial crisis, and then returned to the increasing trend. The trend line mainly reflects changes in income levels that have continuously increased over the past three decades, except for the period of income decline in the two crises.

B. Empirical Results

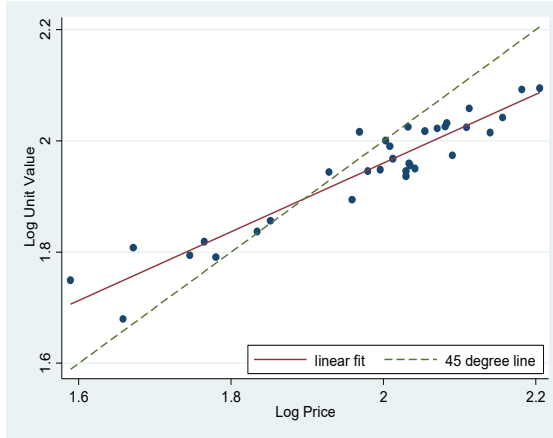

FIGURE 2
QUALITY SHADING TO PRICE INCREASES

FIGURE 3
TREND OF WINE IMPORT AND IMPORT VOLUME

The primary purpose of the empirical work is to separate consumers' qualitative responses to exogenous price changes from existing demand elasticity estimates that do not consider the special features of aggregates. In Chapter III, three consumer responses are modeled: participating in wine consumption, changing consumption through quantitative and qualitative responses, and choosing whether to consume a new variety or discontinue. Here, the empirical analysis only presents the results of Equations (1) and (2) due to data limitations. We

compare these results with the results of two comparable methodologies (standard price and quality-adjusted price methods) to highlight the problems of existing methodologies that fail to properly analyze qualitative responses. Analysis of Equations (3) and (4) is not carried out in this study due to the absence of consumption rate data. The key results of Equations (1) and (2) and a modified version of Equation (1) are presented in the columns of Table 1. The price elasticity in Column (1) is −1.179, which uses Equation (1) only and the usual formula for price elasticity ($\varepsilon_P = \theta / \bar{C} - 1$). This elastic estimate is similar to that of the import demand analysis of wine in Korea by using time series data. The price elasticity of Korea's wine consumption is estimated to be greater than that of other inelastic alcoholic beverages, such as soju and beer (Kim *et al.*, 2015), and the relatively large estimate of wine appears to reflect the characteristics of wine with an elastic qualitative response to price changes.

The coefficient values of the control variables in the models are given in Appendix Table 2. Column (2) is the result of the unrestricted model using Equations (1) and (2) together, with quantitative price elasticity ($(\theta / \bar{C} - \varphi)$ being −0.712 and qualitative price elasticity ($\varphi - 1$) being −0.466. The combined value of the two elasticities is −1.178, which is almost identical to the price elasticity of Equation (1) only. Thus, the standard price elasticity estimation method or standard price method greatly overestimates the effect of consumers' wine consumption growth due to the price decline caused by FTAs. Meanwhile, the statistically significant estimate of qualitative price elasticity ($\varphi - 1$) implies that the value of φ is statistically significantly smaller than 1, indicating the presence of a significant quality shading to an increase in price. The results also confirm the rebuttal of the Cox and Wohlgenant's hypothesis ($\varphi = 1$), which is the basic assumption in many studies that use quality-adjusted prices from the unit values. In stark contrast to the critical assumption of the quality-adjusted price method, our results suggest that substantial quality responses to price changes exist and that there may be no preceded choice of quality or brand; hence, price changes cannot be only quantitative. At the least, this result shows that the underlying assumption of the quality-adjusted price method that does not allow quality shading to price increases does not fit the data used in this study. Moreover, when a quality shading to a high price level exists and the quality-adjusted price derived from Equation (6) is replaced by the price variable in Equation (1), the price elasticity

Table 1
Price Elasticities

	(1)	(2)	(3)
	Standard Price Method (Equation (1))	Unrestricted Method (Equations (1) & (2))	Quality-adjusted Price Method (Equation (1)^a)
Total price elasticity	−1.179** (.488)	−1.178*** (.433)	−1.323* (.808)
Quantity price elasticity		−0.712* (.437)	
Quality price elasticity		−0.466*** (.045)	

The parentheses denote SE, and *, **, and *** respectively represent statistical significance of p<0.1, p<0.05, and p<0.01. a represents the model with the quality-adjusted price variable in Equation (1).

formula is $\varepsilon_P = (\theta/\varphi) / \bar{C} - 1$, which leads to an inflating response of consumption to price. As in the theoretical prediction, the estimate using Cox and Wohlgenant's quality-adjusted price method is −1.323, as shown in the third column of Table 1, which is slightly larger than that of the method that considers only quantity margins.

Appendix Table 2 presents the estimation results of individual variables for the three estimation methods. The R^2 values of the standard price method, unrestricted method, and Cox and Wohlgenant's method are 0.55, 0.93, and 0.55, respectively, revealing the high explanatory power of all the models. The statistical significance of the lagged term variables in all the models is low, which does not support the hypothesis of demand models for other products, such as tobacco and alcoholic beverages that consider addictive properties as a factor.

In addition, the estimate of $\varepsilon_x = \beta^1 / \bar{C}$, which is the usual income elasticity formula for wine consumption, is 1.111, indicating that consumption responds elastically to income changes. However, considering the apparent qualitative response to income levels indicated in Figure 1, the income elasticity formula should be modified as $\beta^1 / \bar{C} - \beta^2$, where β^2 is a qualitative income elasticity that represents a qualitative response to income changes, and the estimate is 0.622. This result suggests that much of the consumption response derived

from the conventional elasticity formula can be attributed to a quality improvement response. This estimate is also consistent with the result of Chen and Juvenal (2018) that the qualitative response to exogenous income changes, such as a global financial crisis, is significant. The study is in line with the disproportionate increase in low-quality varieties in Chile's wine export composition during the 2008 crisis.

V. Conclusion

This study proposed an empirical methodology that distinguishes qualitative responses from consumer responses to exogenous price changes, such as the introduction of an FTA. The use of unit values as a dependent variable for consumers' quality choice, unlike the usual method of utilizing unit values as a proxy for market prices, showed that a qualitative response does exist and its size is significant. The methodology of separating and estimating qualitative responses to income changes during economic crises was also presented and showed that many of the existing income effects are qualitative responses. As a key result, the price elasticity of −1.178 estimated by the usual demand model based on a single commodity assumption is reduced to −0.712 for the intensive margin only, and the extensive margin is the remaining −0.466, accounting for more than a third of the aggregate response. Through an empirical analysis of typical empirical studies using the unit value as a proxy variable for market price, we found that the estimate of Cox and Wohlgenant's quality-adjusted price method is −1.323, which is similar to that of a standard method that considers only intensive margins. This result explicitly shows that the underlying assumption of the quality-adjusted price method, which does not allow quality shading to price increases, does not fit the data.

This study has its limitations and recommendations for future research. First, because the time series data on market price variables are available only to a very limited time span, we could not fully utilize long-term time series data on wine consumption and unit values in our empirical analysis. Second, the price elasticity for new consumption was not estimated in this study because household data specifically for wine consumption are unavailable. This is unfortunate because important policy implications could be derived for FTA effects, such as income levels of new households in demand, if data were available. Future research could examine the price elasticity for new consumption, including the

dynamics of a consumption goods market with information on the entry and exit of consumers/households in the market in response to external shocks. Nevertheless, our analysis highlights the need for explicit consideration of qualitative responses to exogenous price changes caused by the introduction of FTAs or changes in commodity tax and suggests the need to collect key variables, such as market price levels, for the implementation of a complete analysis.

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Appendix Table 1
Descriptive Statistics

Variable	Mean	S.D.	Min	Max
C_t (wine consumption)[a]	7.91e+06	7.77e+06	3.13e+05	2.44e+07
lnv_t (log unit value)[a]	1.745	0.102	1.479	1.894
lnP_t (log import price)[b]	1.976	0.156	1.589	2.204
x_t (GDI per capita)[b]	1.766e+07	0.967e+07	0.339e+07	3.449e+07
z_t (adult population)[c]	3535.4	468.0	2686.4	4273.3

Note: The units of [a], [b], and [c] variables are USD, KRW (Korean Won), and 10,000 people, respectively.

Appendix Table 2
Empirical Results by Models

	Standard Price Model	Unrestricted Model		Quality-adjusted Price Model
	Equation (1)	Equation (1)	Equation (2)	Equation (1)[a]
lnP_t	−1.321	−1.316	0.534	−2.392
	(3.612)	(3.206)	(0.044)	(5.978)
lnx_t	−108.708	−108.708	−0.820	−115.392
	(93.101)	(82.638)	(1.163)	(97.037)
t	6.698	6.687	6.838	6.838
	(5.621)	(4.989)	(5.683)	(5.683)
t^2	−0.009	−0.009	−0.0090	−0.009
	(0.008)	(0.007)	(0.007)	(0.008)
z_t	0.003	0.003	0.000	0.003
	(0.008)	(0.007)	(0.000)	(0.008)
lnv_{t-1}			−0.111	
			(0.071)	
C_{t-1}	0.157	0.160		0.160
	(0.200)	(0.177)		(0.199)
Constant	−498.136	−496.189	−18.755	−479.346
	(715.509)	(635.096)	(10.140)	(689.146)

The parentheses denote SE, and [a] represents the model with the quality-adjusted price variable in Equation (1).

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