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Article

Determinants of bottled water consumption and demand analysis of related goods: The Italian market case

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Abstract: This paper provides a comprehensive analysis of the Italian bottled water and non-alcoholic beverage industry by examining the market dynamic from 1980 to 2020 for the bottled water and demand patterns from 2011 to 2020 for the non-alcoholic beverages. With originality, this study integrated two quantitative approaches by implementing a dynamic equation in both the Weighted-OLS (WLS) models—which we control for fixed-effects models—and the Linear Approximate-Almost Ideal Demand System model (LA/AIDS). Our outcomes indicate that operative volumes in the bottled water industry are significantly influenced by their past value, temperature, population trends, and per-capita disposable income. The LA/AIDS model shows that both soft drinks and bottled water are price-elastic, while juices display price-inelasticity relative to both. The income elasticity of all three beverage categories suggests they are normal goods, but they are at the boundary of the classification between necessary and luxury goods. In addition, bottled water is the most widely consumed good, followed by soft drinks and juices. Finally, socio-economic implications of the bottled water industry and broader non-alcoholic beverage industry have been highlighted, ultimately emphasizing the need for policy interventions at various levels, for instance regarding the environmental and economic impacts from the bottled water and non-alcoholic beverage industries and the promotion of healthier consumption habits.

Keywords: bottled water; non-alcoholic beverage; consumption; dynamic model
JEL codes: L66; D12; C51; L10; M21; M30; Q01

1. Introduction

Access to drinking water[1], a vital natural resource essential for life, is arguably one of the most valuable common goods available, yet it has also been a source of conflict in various global regions [1,2]. Resources like spring water are defined as open-access commodities featuring low levels of excludability and high rivalry among users.

The pressing issues of water scarcity and the impacts of climate change, exacerbated by globalization, have prompted a renewed focus on these pivotal topics within economic discourse and other fields [3–9]. Notably, the bottled water industry serves as a prime illustration of the contemporary global marketplace [10–12].

In light of these reflections, it is imperative to foster discourse among scholars specializing in business economics and management regarding the increasingly significant phenomenon of bottled water marketing, which has gained traction across various markets [13–15].

The matter of water availability possesses considerable significance and relevance in contemporary discussions, transcending merely the challenges faced by developing nations or issues related to hydrogeological desertification. It now requires analysis through the lens of climate-related effects. The interplay between climate change and resource consumption necessitates an exploration of potential determinants of water waste. In this context, bottled water faces scrutiny for its substantial environmental footprint and implications for consumer pricing. While naturally occurring drinking water is readily available yet finite, the distribution of bottled water is monopolized by a limited number of suppliers, resulting in market concentration and the establishment of considerably elevated average costs per liter of bottled water [16].

Numerous studies have delved into the bottled water industry across various countries in the last decade [17–25]. Researchers have also examined the correlation between bottled water and non-alcoholic beverages through a demand analysis framework [26–29]. These scholarships have ultimately advanced the existing knowledge of bottled water and its associated industries, offering a thorough and current perspective on the subject.

Nevertheless, concerning the Italian market, to our knowledge, there exists a gap in the literature regarding studies that investigate both the growth of the industry and consumer behavior using a demand system approach [30–32].

In fact, Italy, characterized by its abundant water resources and significant regional disparities, presents a compelling and lucrative market for the bottled water industry and its ancillary products. This industry carries notable implications for national productivity and employment levels [33,34].

Therefore, this paper provides a comprehensive analysis of the Italian bottled water and non-alcoholic beverage industry by examining the market dynamic from 1980 to 2020 for the bottled water and demand patterns from 2011 to 2020 for the non-alcoholic beverages. With originality, this study integrated two quantitative approaches by implementing a dynamic equation in both the Weighted-OLS (WLS) models—which we control for fixed-effects models—and the Linear Approximate-Almost Ideal Demand System model (LA/AIDS). Bottled water industry firms operate just-in-time, and demand peaks due to seasonality or other factors, such as incremental consumption caused by the tourist presence, are possible. Furthermore, firms also have the opportunity to exploit economies of scale and scope by bottling in a large quantity, by producing correlated and diversified goods.

The declared aims of the paper are to investigate: (i) the determinants in explaining bottled water consumption and the industry's life cycle in Italy; (ii) the demand for goods of the non-alcoholic beverages industry, such as bottled water, soft drinks, and juices, using the Linear Approximated (LA) Almost Ideal Demand System (AIDS) and lagged variables to capture the persistence effect of consumption patterns over time [35–37].

The remaining work is structured as follows: (i) the industrial dynamics; (ii) the determinants of bottled water consumption; (iii) the model for demand analysis; (iv) conclusions.

2. The industrial dynamics

2.1. Industry concentration

Over the past century, the perception of water has shifted from being a freely available and essential natural resource to becoming a highly marketable item and a lucrative venture for businesses in the industry. Typically, bottled water consumption escalates with rising per-capita income, with pricing potentially increasing by up to five hundred times compared to tap water [38]. As a result, the choice to consume bottled water often symbolizes a lifestyle of affluence and is frequently regarded as a healthier or safer option. This perception is largely driven by the investments made in marketing and communication efforts by bottling firms in the industry [5,39,40].

In economics, the concept of substitutable goods refers to items that satisfy analogous consumer needs to a comparable degree, whereby a price increase in one leads to higher demand for the other. This phenomenon occurs particularly when consumer decisions are largely influenced by the relative pricing between these goods [41]. However, while this principle may be applicable in the context of the non-alcoholic beverage industry, it can be seen as misleading when consumption choices incorporate factors beyond mere price considerations [42]. Thus, consumer decision-making becomes intricate, as it is shaped by a variety of elements that extend past the basic need for hydration or simple price comparisons. Variables such as brand reputation, health considerations, and flavor inclinations, in addition to price advantages, invariably influence consumers' choices [43–45]. Therefore, to classify two goods within the non-alcoholic beverage realm as interchangeable is not necessarily a straightforward assertion, particularly in mature markets or those wherein the average quality of a product does not drastically differ from its competitors.

The non-alcoholic beverage industry inherently exhibits substantial entry barriers, as the utilization of water resources necessitates approval from regional authorities. Furthermore, existing players in the market may opt to reduce their sales prices to a level equivalent to the total average cost of production that a new entrant faces. Consequently, any new competitor would be compelled to function below the minimum efficient production scale, which is indicated by its marginal costs. These aspects create considerable challenges for newcomers attempting to penetrate a market where high economies of scale and scope are present [46–49].

Notably, the bottled water segment serves as a primary illustration in Cournot's oligopoly model, wherein the production's marginal cost is largely approximated by the cost of bottling, and the sunk costs associated with starting the business are represented solely by the fees incurred for resource usage [50,51].

The lucrative potential within the non-alcoholic beverage industry has drawn the interest of major multinational corporations, including Nestlé, Danone, and Coca-Cola, which operate within the industry through proprietary commercial channels or marketing partnerships. In conjunction with prominent Italian brands, these firms have likely heightened the competitive landscape of the market [52].

Water constitutes the primary input for the manufacture of soft drinks and juices, thus creating a direct linkage and vertical integration between these two industries. The concentration within the Italian industry has its roots in the 1970s, a period during which firms initiated competitive strategies emphasizing horizontal expansion and marketing differentiation. The industry's competitive structure has since been consolidated, with a significant degree of concentration and several groups present in both markets (**Table 1**).

Although they can be extremely different, it is possible to identify three major categories of firms operating in the industry: (i) smaller firms, some of which are old and family-owned, that manage and market specific regional brands; (ii) bigger national firms and groups, which own brands spread throughout the national territory; (iii) international groups, which can take advantage of their large worldwide network and know-how.

Table 1. The top groups in the Italian industry and their market shares in 2020.

	Bottled Water		**Non-alcoholic Beverages**	
Ranking	**Groups**	**Mrk Shares (%)**	**Groups**	**Mrk Shares (%)**
1	Nestlé Italy	19.0	Coca-Cola HBC Italy	33.0
2	San Benedetto Mineral Water	18.0	San Benedetto Mineral Water	14.0
3	Vinadio Springs	9.0	Nestlé Italy	11.0
4	Italy Mineral Waters	7.0	Refresco Italy	7.0
5	L.G.R. Holding	6.0	PepsiCo Beverages Italy	6.0
6	SGAM	6.0	Ferrero	6.0
7	Co.Ge.Di. International	5.0	Sibeg	5.0
8	Refresco Italy	4.0	IBG	4.0
Top-four		53.0		65.0
Top-eight		74.0		86.0

Source: Adaptation from Bevitalia [33,34].

When concentration increases in an industry, this translates into an increasing market share being held by a decreasing number of firms. The industry concentration is especially highlighted by the CR_4 index calculated by adding the market shares of the top-four groups [53]. For values below 40%, the industry is considered to be characterized by the competition between the firms. For values above 40%, the industry is considered to be characterized by limited competition. For values above 60%, the industry is considered to be characterized by limited competition and dominant firms.

Although the number of firms and brands present in the two markets is high, the industry is structurally characterized by a high degree of concentration, with the values of CR_4 indices above 40% and 60% in the two markets, respectively. By adding the top-eight groups active within the markets, its value drastically increases, making the industry concentration even more evident[2]. As a result, a high market power is held by the market-leading firms controlling more than half of the operating volumes.

This suggests that higher levels of market concentration for uniform productions can provide for leader firms the opportunity to shape industry structure in ways that benefit them financially and economically. In fact, the industry of non-alcoholic beverages in Italy is comprised of a diverse array of enterprises, ranging from large, multifaceted corporations to smaller firms that exhibit a strong local orientation.

The former category possesses the resources to engage in internationalization strategies, a necessity in the current climate to mitigate the stagnation observed in domestic markets. Conversely, the latter group tends to be constrained by their regional focus and frequently lacks robust marketing capabilities.

2.2. Competition within the industry

Water, along with various non-alcoholic beverages, is typically classified as a straightforward commodity, often necessitating minimal or no supplementary resources in the production chain. Nevertheless, through strategic branding, marketing, and packaging efforts, firms have successfully cultivated the perception of non-alcoholic beverages as luxury items among consumers. This transformation has been facilitated by intentional marketing strategies that emphasize product differentiation [18,54,55]. The industry is characterized by its dynamism, with a multitude of producers vying for market share. Firms within this industry have adopted marketing methodologies focused on enhancing value-added components or emphasizing the perceived advantages of their products or services by incorporating additional features absent in bottled water. However, this approach may inadvertently trivialize the product. The prevalent belief that bottled water is cleaner, safer, or less contaminated than tap water can be attributed to the marketing campaigns employed by these firms. Commonly, firms utilize phrases such as “pure” or “refreshing” to promote their products, though these terms often serve as clichés that fail to convey substantive information about the actual quality of the water or empirically supported benefits of consumption. Consequently, this marketing practice has heightened the competitive landscape within the industry, as bottling services strive to meet the fundamental human necessity of hydration. Thus, the industry experiences intense competition, compelling firms to adopt varied marketing strategies to thrive, including expanding into new markets through partnerships or by distinguishing their products from competitors.

Firms can adopt a multi-branding strategy. Most brands are regional or local, and only a few are nationally diffused. However, this inevitably creates a difficult condition for the consumers, who must inevitably choose among numerous brands apparently referring to homogeneous products. The industry is mature, the products are highly differentiated, and there is a high penetration degree among consumers. As a result, in the industry, competition has intensified and has been affected by the firms’ marketing strategies. Particularly, small and medium-sized firms adopt low-price policies, while the biggest firms compete through all the levers of the marketing mix, paying attention to the consumer behaviors in order to rapidly achieve successful performance. Therefore, in a concentrated industry like this, strong marketing competition has pushed firms to distinguish their products through branding, labeling, packaging policies, and advertising campaigns. Smaller firms face pronounced challenges stemming from heightened entry barriers in the industry, largely attributed to the substantial marketing expenditures of larger competing firms. This phenomenon suggests that the Italian non-alcoholic beverage industry has reached a stage of maturity wherein managerial decisions assume considerable importance. Leading firms are characterized by their capacity to maintain significant operative volumes and their financial prowess to invest in marketing initiatives.

This structural dynamic ultimately disadvantages smaller competitors. Despite having similar distinctive attributes, these firms struggle to secure substantial market shares, while established players have the opportunity to enhance their market positions through strategic mergers and acquisitions [56]. Within such an environment, there exists a considerable disparity between average production costs and average revenues.

Consequently, the allocation of retail and marketing expenses across larger operative volumes creates advantages. Firms with elevated operative volumes can mitigate the impact of average retail costs on their total production expenses through economies of scale and scope, thus enabling them to offer more competitive pricing relative to their rivals [57]. As a result, the horizontal differentiation of products emerges as a vital competitive strategy for firms in delineating the symbolic attributes associated with their offerings. This strategy hinges on the consumer's perceived value of products; hence, a diverse array of brands and packaging is readily available in the marketplace [5,39,40]. The design of bottles and packaging often plays a pivotal role in the market positioning of non-alcoholic beverages. Bottled water, primarily serving a physiological function, experiences a transformative refinement process that bestows it with new significance, particularly in light of the expansive marketing endeavors that have fostered innovative packaging, promotional approaches, and evolving consumer habits.

Another important discriminating factor for the firms' strategies is transportation costs, in addition to crucial marketing investments and advertising campaigns. For an effective implementation of the brand differentiation strategies, the advertising campaign plays a fundamental role [33,34]. In fact, firms with the highest market shares can be top spenders in the industry. Investments in marketing, advertising, and, in general, value creation by branding and distribution impact business performance and industry profitability. As a result, consumers may prefer to buy locally sourced water because it has a lower final price [58,59]. Nonetheless, this does not affect the movement of bottled water stocks across regions in Italy, and consumers' choice process may be based more on invoking emotional factors and brand perception.

In the last decades, the competitive dynamics intensification in all industries due to globalization both in developed and developing economies has led firms to adopt competitive strategies and growth processes capable of guaranteeing them a strong and defensible competitive advantage [60,61]. In fact, the exports absorb a significant share of the operative volumes of the biggest internationalized groups in the industry [33,34]. In fact, globalization can increase competitive pressures on management and firms' corporate governance [62–65]. However, international markets can also represent a meaningful opportunity for business decision-makers when they are able to capitalize on the benefits arising from the firms' expansion towards foreign markets [66–72]. For example, in emerging markets where a new middle class has shifted their general consumption preferences towards more Western styles [38,73–75].

2.3. The theory of industry life cycle and the Italian case

The theory of the industry life cycle posits that industries evolve through a series of distinct phases, each characterized by unique attributes and challenges [76–79]. The model delineates four primary stages: (i) introduction, (ii) growth, (iii) maturity, and (iv) decline. Furthermore, an additional revival stage may be recognized, wherein an industry may experience a resurgence in growth following a decline.

During the introduction phase, a novel product or service makes its debut in the market. This stage is marked by minimal competition and low market concentration, accompanied by significant uncertainty regarding sales and substantial sunk costs tied to unique investments. Consequently, sales and profits remain modest, compelling firms to prioritize consumer awareness through targeted advertising and promotional efforts.

As the industry transitions into the growth phase, it witnesses a surge in demand, sales figures, and profitability, alongside enhanced product or service differentiation. Increased competition becomes apparent, with the market attracting new entrants. Costs per unit decline due to the realization of economies of scale and scope, prompting firms to recalibrate their objectives towards expanding market share and fostering brand loyalty.

In the maturity phase, growth rates for demand, sales, and profits begin to taper off. This period is characterized by intensified competition and potential market consolidation. Products or services during this stage achieve a high degree of standardization. Consequently, firms' strategies evolve to focus on sustaining market share and optimizing profits through cost leadership and improved operational efficiency, although opportunities for innovation or the introduction of new products are limited.

The decline phase witnesses a reduction in demand, sales, and profitability. Competition may diminish as certain firms withdraw from the market, although exit barriers can be substantial. In this stage, firms prioritize cost management and cash flow generation over aggressive sales growth.

It is pertinent to acknowledge the theoretical limitations of this model, as not all industries conform flawlessly to its framework. Certain industries may undergo swift technological advancements or face disruptive innovations that can expedite or even circumvent specific developmental stages. Moreover, fluctuations in demand may arise from cyclical influences stemming from economic conditions or other external factors. Consequently, the characteristics of each phase can vary significantly based on the specific industry context and external elements, including technological progress and shifts in consumer behavior. Hence, the industry life cycle theory aligns with the AIDS model, facilitating a deeper comprehension of the dynamic interplay within various markets and industries, as well as the impact of consumer behavior on their consumption patterns over time.

The bottled water industry operates within the broader non-alcoholic beverage industry, which encompasses soft drinks and juices. Despite certain distinctions in product offerings, production facilities, and target demographics, these two industries encounter analogous challenges pertaining to production, distribution, packaging, and marketing.

This indicates that firms within the non-alcoholic beverage industry, primarily those involved in the production of bottled water, soft drinks, and juices, frequently maintain a varied range of products and prices [5,58]. In essence, these firms are capable of manufacturing several different beverage types within a single facility. For instance, the establishment of a diversified production line allows these firms to capitalize on economies of scope, which denotes the cost advantages realized when multiple products are produced simultaneously rather than separately. By generating bottled water, soft drinks, and juices at one site, these firms can optimize shared resources and manufacturing processes, thereby reducing the marginal costs associated with production. To harness such benefits, it is imperative for firms to have flexible production methodologies and adaptable equipment. This flexibility facilitates a swift and efficient transition between different beverage productions as needed, all while avoiding the necessity for additional investments in new machinery or infrastructure. A manufacturing facility that encompasses the production of bottled water, soft drinks, and juices can implement production lines that are readily reconfigurable for product switching, ultimately enhancing overall production efficiency.

There is a long tradition in Europe for drinking bottled water. The consumption of bottled water was developed at the end of the 19th century in some European countries with a strong wellness tradition, such as Italy, France, Belgium, and Germany, with the start of bottled water from thermal springs.

In Italy, up until the mid-1970s, the consumption of bottled water was largely associated with therapeutic qualities, its availability being primarily localized and confined to a relatively affluent demographic. However, the growth of the bottled water industry commenced in the subsequent decades of the 1970s and 1980s, during which bottlers implemented strategies aimed at both geographic and economic expansion. A pivotal factor contributing to the surge in consumption was the shift from glass to plastic packaging, which enabled firms to significantly lower their costs related to transportation and distribution. By the 1990s, Italy emerged as the leading country in Europe in terms of bottled water consumption and export values [33,80]. This leadership is underpinned by a deeper cultural tradition of bottled water consumption and an increasing consumer awareness regarding health and personal well-being. Consequently, bottled water has become a central industry within the broader non-alcoholic beverage industry.

Figure 1 depicts the trends in operative volumes of bottled water from 1980 to 2020, illustrating a typical s-shaped curve of industry growth. Bottled water consumption has increased substantially since the 1990s. The reasons for this growth primarily include lifestyle changes and consumption habits [81]. The industry has progressed into a shake-out phase, subsequently entering a stage of maturity. According to the life cycle theory of industry, it is apparent that oligopolistic competition aptly characterizes the market structure during these phases. Weaker market participants are likely to exit the industry, while new entrants face significant challenges in gaining access.

Consumers now exercise greater agency in their purchasing choices, which may lead to a decrease in operative volumes for established firms as competition in marketing intensifies. In light of this dynamic, these firms must increase their marketing investments to sustain their market positioning in both domestic and international arenas. Amidst steady growth in output across the industry, certain dominant firms have emerged, able to command premium prices and demonstrating strong distribution networks across various regions, both local and global.

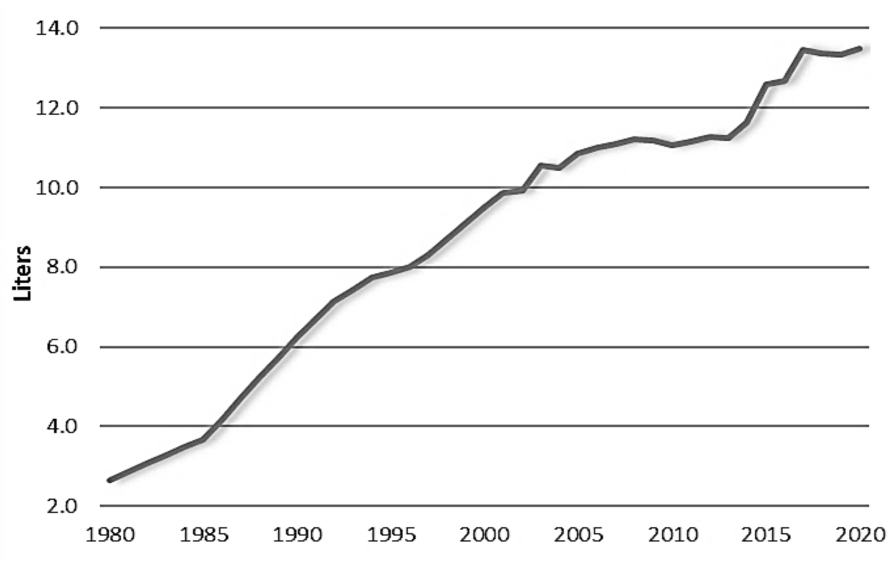


Figure 1. The Italian bottled water industry life cycle, billions of liters.
Source: Our reconstruction on Bevitalia [33] and ISTAT data, per-capita liters and middle population.

In Italy, the purchase of bottled water has been well-established and cross-structured by income groups, ages, and geographical areas for several decades now. This growth can be attributed to at least three qualitative contingent factors [21]: (i) the use of polymers in packaging, resulting in significant cost savings for firms but contributing to environmental problems; (ii) a greater consumer focus on personal health; and (iii) a careful strategy of brand differentiation by firms through the use of operative marketing levers. On the other hand, from a quantitative standpoint, factors such as individuals' willingness to spend money and their consumption styles, or even the climatic situation of the period, which affects the organism's need for water and modifies the amounts of water required, can impact the consumption of bottled water.

Italy is the first European country for consumption of bottled water and exported volumes [33]. It is a country rich in water resources, but there is also a great deal of differentiation between regions in the north, center, and south as regards the relative abundance of resources, access to markets, and distribution networks. For instance, based on the hydrogeological configuration and the particular orographic conditions, Umbria is a region very rich in water resources. In another way, Umbria is the Italian region leading in bottling and consumption, where many firms and groups are located. Cogedi is the owner of established brands, such as Oliveto and Rocchetta. Motette is one of the best-performing groups in the industry. Siami is a dynamic group with growing sales [33,80,82].

The bottled water industry in Italy creates an interesting and profitable market with important implications for productivity and employment. As a result, in an industry whose output has steadily increased, there are some leader brands with high price points and strong distribution capacity in both domestic and international markets.

3. The determinants of bottled water consumption

From a broader perspective, research conducted in both developed and emerging markets indicates that the factors influencing bottled water consumption include [83–

85]: (i) the average age of households, (ii) the average educational attainment, (iii) a considerable level of disposable income, and (iv) the gender composition favoring males. These and other factors can contribute to the growth of bottled water consumption. In fact, firms operate just-in-time, and demand peaks are possible due to seasonality or other factors, such as incremental consumption because of tourist presence.

A diverse array of socio-economic and cultural variables, such as ethnicity, age, financial status, employment, and gender, play a significant role in shaping bottled water purchasing behaviors. However, these purchasing patterns may differ significantly across various countries or regions [43]. Conversely, factors such as the health attributes of the water and the sensory properties highlighted on the packaging appear to be less influential on consumer choices [5,40,44,45].

3.1. Materials, methods, and instruments

The analysis utilizes aggregated data pertaining to ISTAT macro-markets, specifically examining the northwestern, northeastern, central, and southern regions, including the two islands. In the context of the literature review aimed at elucidating the operative volumes of bottled water consumption, we mainly consider the following aspects: (i) the dependent variable with one order of lags helps to control for the bias from the serial correlation, and positing this as an indicator of established consumption patterns, thus suggesting that marketing investments by firms at time-*t* implicitly affect purchasing behavior; (ii) the trend of average temperatures, reconstructed through a barycentric calculation for each macro-market, taking into account the two primary cities as per ISTAT data; (iii) population trends within these markets; (iv) per-capita disposable income. Further controls have included, for data available from 2000 to 2020; (v) the tourist presence; (vi) the splitting of population for age ranges (0–14, 15–65, over-65), and (vii) the time trend contributing to stabilizing the estimates.

The time series data regarding the operative volumes of bottled water spanning from 1980 to 2020 was compiled and reconstructed through the integration of Bevitalia [33] survey, while additional data sources were drawn from the ISTAT-Time Series dataset[3]. **Table 2** presents the principal descriptive statistics for the logged variables. The H_θ indicator[4], which we utilize to assess panel heterogeneity, indicates that the mean heterogeneity is minimal, with a group mean of 0.02 and a standard deviation of 0.15.

Moreover, **Table 3** delineates the statistical relationships at the panel level for the regressors, revealing a multicollinearity problem and potential heteroscedasticity in the regressions, which we decided to address with the correct but less conventional Weighted-OLS (WLS) models the cross-sectional variance of the sample. The WLS-estimates with panel data use weights based on the estimated error variances of the respective cross-sectional units. This means that the residuals are recalculated using the available WLS-estimates for the parameters, providing a new set of weights.

By iterating the procedure, the parameters converge to maximum likelihood. We also added categorical dummies for the four macro-markets for stabilizing estimates and detecting the unobserved heterogeneity. Tests for heteroscedasticity annexed to the models, respectively, show that the approach used to treat this is correct, and it is not possible to reject the null. Finally, we perform a robustness check by implementing a fixed-effects model using Driscoll-Kraay [86] robust standard errors, also given the presence of the cross-sectional dependence due to our panel structure with large T and small N, as confirmed by Pesaran's [87] CD-test. Furthermore, we can also provide a theoretical justification, namely that the cross-sectional units refer to one market.

Employing this estimation strategy affords the benefit of achieving efficient parameter estimates despite the presence of correlation among the regressors or varying measurement units. Additionally, it allows for control over effects potentially introduced by omitted significant variables. The parameters in the models were estimated with the open-source statistical software Gretl.

Table 2. The main descriptive statistics of log variables.

	Operative volumes	Temperature trend	Per-capita disposable income	Population trend	Tourist presence
μ	7.554	2.748	4.568	7.240	3.474
σ_w	0.485	0.051	0.584	0.034	0.166
σ_b	0.301	0.083	0.000	0.301	0.643
min	6.190	2.551	3.050	6.941	2.237
Max	8.438	2.909	5.129	7.646	4.205
Unit	4.000	4.000	4.000	4.000	4.000
Obs.	41.000	41.000	41.000	41.000	21.000
Std.	liter	°C	Euro	unit	unit

Source: Our elaboration.

Table 3. The correlation between variables used in the regression model.

	Operative volumes	Temperature trend	Per-capita disposable income	Population trend	Tourist presence
Operative volumes	1.000				
Temperature trend	0.609***	1.000			
Per-capita disposable income	0.872***	0.416***	1.000		
Population trend	0.546***	0.519***	0.075	1.000	
Tourist presence	−0.570***	−0.720***	0.176	−0.679***	1.000

Note: (***) significant for $\alpha = 0.01$; (**) significant for $\alpha = 0.10$. Source: Our elaboration.

3.2. Outcomes and discussion

Following the consideration of individual effects, the adjusted model, which incorporates controls for four macro-market dummies that do not yield significant results and display comparable impacts, generates more robust estimates. This reinforces the hypothesis related to the rise in operative volumes of bottled water. Consequently, market dynamics contribute to their growth over time while also exhibiting positive correlations, particularly with the trend of average temperatures during the specified period, as well as with per-capita income trends and population growth. The parameters estimated in this analysis are uniformly positive and statistically significant (as illustrated in **Table 4**). The model from 1 to 3 shows the WLS-estimates employing dummy variables to grasp the composition effects of the panel considering the four identified macro-markets. While models 4 to 6 show a robustness check for the estimates of the previous models, respectively. Comparing these models, we observe that the magnitudes and signs are similar, and the statistical significance of parameters is respected. Therefore, we conclude that the WLS-estimates are consistent and robust after controlling for the cross-sectional dependence in the panel data.

Table 4. Comparison between regression models.

	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
	WLS	**WLS**	**WLS**	**FE**	**FE**	**FE**
	Operative volumes					
Operative volumes (*t*-1)	0.784***	0.715***	0.676***	0.785***	0.723***	0.680***
	(0.040)	(0.062)	(0.065)	(0.082)	(0.100)	(0.124)
Temperature trend	0.243***	0.227***	0.228***	0.236***	0.216**	0.214 **
	(0.054)	(0.059)	(0.061)	(0.070)	(0.006)	(0.096)
Per-capita disposable income	0.152***			0.150**		
	(0.034)			(0.058)		
Population trend	0.351***		0.361**	0.340***		0.363*
	(0.104)		(0.148)	(0.112)		(0.186)
Population 0–14		−0.052			−0.049	
		(0.054)			(0.035)	
Population 15–65		0.593**			0.576**	
		(0.244)			(0.218)	
Population over-65		0.595***			0.610	
		(0.215)			(0.404)	
Tourist presence			0.011			0.015
			(0.022)			(0.024)
North-Western effect	−2.202***	−5.448***	−0.790			
	(0.775)	(2.017)	(1.143)			
North-Eastern effect	−2.151***	−5.154***	−0.772			
	(0.741)	(1.913)	(1.094)			
Centre effect	−2.182***	−5.206***	−0.792			
	(0.746)	(1.923)	(1.095)			
Southern effect	−2.281***	−5.624***	−0.821			
	(0.806)	(2.083)	(1.179)			
Constant				−2.107***	−5.360	−0.813
				(0.657)	(3.354)	(1.139)
Time-trend	−0.002***	−0.005	0.003*	−0.002	−0.006	0.003
	(0.001)	(0.003)	(0.001)	(0.001)	(0.006)	(0.002)

Table 4. (*Continued*).

	(1)	(2)	(3)	(4)	(5)	(6)
	WLS	**WLS**	**WLS**	**FE**	**FE**	**FE**
	Operative volumes					
Standard error	0.023	0.021	0.021	0.023	0.021	0.021
Log-likelihood	381.453	213.146	209.244	381.020	212.723	208.848
Heteroscedastic-test (*p*-value)	(0.834)	(0.839)	(0.851)	(0.917)	(0.922)	(0.900)
CD-test (*p*-value)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Convergence iterations	4	4	4	-	-	-
Not observation (%)	4 (2)	4 (5)	4 (5)	4 (2)	4 (5)	4 (5)
Observations (%)	160 (98)	80 (95)	80 (95)	160 (98)	80 (95)	80 (95)

Note: (***) significant for $\alpha = 0.01$; (**) significant for $\alpha = 0.05$; (*) significant for $\alpha = 0.10$. Source: Our elaboration.

In Italy, the consumption of bottled water, when evaluated across the four ISTAT macro-markets (northwestern, northeastern, central, and southern regions, including the two islands), exhibits a positive and significant relationship primarily with operative volumes lagged by one period and secondarily with fluctuations in the average temperature trend over time [88]. The geographical popularity of bottled water consumption persists across all regions, although certain disparities have diminished over time [80]. The widespread use of bottled water can largely be attributed to the abundance of natural springs in various locales.

One noteworthy factor is the income disparity between northern and southern regions. It is perhaps not coincidental that the southern macro-market shows a high consumption rate of bottled water, with firms successfully achieving advantageous product positioning correlated to their pricing strategies [5]. Firms employing a competitive pricing approach may also opt to raise operative volumes from nearby markets to enhance profitability. Nevertheless, consumers are willing to pay elevated premium prices for bottled water as a result of effective brand positioning initiatives executed by firms through marketing mix strategies, which aim to maximize the breadth of product lines offered [5,39,40].

Our regression models have also revealed that the tourist presence perhaps did not contribute to bottled water consumption. The magnitude of its coefficient is irrelevant and not statistically significant. Furthermore, the splitting of the population into age ranges has highlighted how bottled water consumption is higher among the population aged over 15 years. In particular, we have found that the effect for the population aged between 15 and 65 years is statistically significant and robust after checking the fixed-effects model. Finally, the negative sign reported by the variable representing the population aged 0–14, mainly encompassing younger people, is noteworthy, and it may be explained by their different drinking consumption habits.

4. The model for demand analysis

The Almost Ideal Demand System (AIDS) model emerged in the latter part of the twentieth century and has since been widely utilized in empirical investigations, particularly following the foundational contributions of Deaton and Muellbauer

[89,90]. The model rests on several core tenets: (i) it serves as an effective approximation for various demand types, (ii) its framework is predicated on the rational choice theory regarding consumer decision-making, (iii) it offers a representation of economic consumer behavior, (iv) its linearly approximated variant is the most straightforward to apply, and (v) linear constraints can be placed on parameters to uphold the model's conditions of homogeneity and symmetry, which are verifiable with relative ease.

In this study, we adopt the Linear Approximate-Almost Ideal Demand System (LA/AIDS), frequently employed in econometric analyses, in lieu of the original system [91]. The primary benefit of the LA/AIDS model lies in its lower computational demand compared to alternative formulations, such as the quadratic model, which necessitate the estimation of a greater number of parameters. This simplification enhances the model's interpretability and ease of implementation. However, the LA/AIDS framework presumes a linear correlation between expenditure and budget shares, potentially constraining its capacity to accurately reflect non-linear demand patterns.

The relationships between expenditure shares and budget shares may prove to be significant; thus, the selection of the LA/AIDS model is informed by a balance between the desired flexibility of the model and the practical econometric efficiency observed, alongside the potential for meaningful linear associations. For this analysis, we employ the price index established by Stone [92] as a substitute for the original trans-log price specification. Stone's price index is advantageous due to its absence of unknown parameters, allowing for straightforward incorporation into the system. Additionally, as an innovative approach, we included lags of consumed budget shares in the price equation attributed to Stone [92], aiming to jointly capture persistence effects resulting from both income fluctuations and price changes.

By utilizing an alternative formulation of the consumer price index within the LA/AIDS model, we are able to generate results that align reasonably well with those produced by the original model, thus circumventing issues of simultaneity among the variables in the equations. This presents a compelling rationale for the inclusion of Stone's price index, as our objective is to develop a demand system that is not only verifiable but also characterized by minimal complexities. Furthermore, by employing the consumer price index as a proxy for trending prices, we eliminate concerns associated with variations in measurement units.

Consumer preferences play a pivotal role in demand analysis, given that consumers often develop consumption habits that are indicative of their interactions with specific categories of goods. Consequently, the demand for various products can be influenced not solely by price and disposable income but also by particular investments made by firms in marketing and R&D with the aim of influencing consumer behavior and preferences, which we have proxied by the disposable income of goods with one order of lags.

In our analysis, we examine the immediate purchasing behaviors of consumers by integrating operative volumes of goods with one order of lags into the models, thereby effectively also addressing the simultaneity issue of variables within the equations. Additionally, we introduce a time trend to account for shifts in consumption patterns over time. The incorporation of operative volumes with one order of lags into the econometric framework is justified for, at a minimum, two reasons. Firstly, it mitigates the potential for autocorrelation bias often encountered in time-series analyses; the inclusion of lagged terms serves to correct for this bias. Secondly, it allows us to delineate the influence of preceding values of a variable on its current manifestation. In our context, integrating a lagged demand level as a predictor variable aids in elucidating the effects of previous disposable income on present consumer behavior. Ultimately, the introduction of variables with one order of lags within the econometric model offers enriched insights into the foundational relationships between variables while simultaneously improving the accuracy of our estimations. Our demand system is structured around three distinct equations, each corresponding to the budget share consumed for the *i*-good. Therefore, it has been implemented as follows (1):

$$w_i = \alpha_i + t_i + \vartheta_i ln x_{i,t-1} + \sum_{j=1}^{n} \lambda_{ij} ln p_j + \beta_i ln \frac{Y}{P} + u_i;$$
$$w_i = \frac{x_i}{Y}; \quad Y = \sum_{i=1}^{n} x_i; \quad P = \prod_{i=1}^{n} p_i^{w_{i,t-1}} \tag{1}$$

where, with reference to one time unit (t): w_i is the consumed budget share of the *i*-good—if $w_i \in (0.5; 1)$, it can be interpreted as a subsistence expenditure; otherwise, if $w_i \in (0; 0.5)$, it is an accessory expenditure, while if $w_i = 0.5$, this is a borderline case; α_i is the constant in the equations; t_i is the time-trend effect; x_i is the disposable income of the *i*-good, and it is equal to operative volumes; $p_{i|j}$ is the consumer price index of the $i|j$-good; Y is the total disposable income in the system; P is a combination of the consumer price indices of the n-goods according to formulation by Stone [92]; and u_i is the error term of regressions.

The assumption of weak separability within consumer utility functions represents a crucial condition for examining the goods that are central to our analysis [89,90].

This assumption carries considerable importance for Hicksian demand theory. In this framework, Hicksian demand accounts for variations in income and the prices of other goods to determine the quantity of a product that a consumer is inclined to purchase at a specific price point. The principle of weak separability is essential for the validity of this theory, as it enhances our comprehension of consumer reactions to price alterations and informs the modeling of their behavior.

The Hicksian demand model bears significant ramifications, particularly for the decision-making processes of policymakers. It serves, for instance, to evaluate the effects of well-being policy amendments on consumer decision-making.

By relying on the notion of weak separability, multiple goods can be classified into three distinct product categories. Under this conceptual framework, the Hicksian demand for a specific item remains unaffected by fluctuations in the prices of other items. Consequently, when the price of one good is altered, its Hicksian demand can be independently assessed from the Hicksian demands for other items. This leads to the understanding that weak separability presupposes that consumer preferences can be viewed as additive, indicating that the utility obtained from consuming a collection of goods is equivalent to the aggregate of the utilities associated with each individual good. Even amidst price changes for one good, consumers can still achieve utility maximization by maintaining consistent quantities across both goods. This simplification facilitates the analysis of how variations in income or prices influence consumer choices within a demand framework.

Another noteworthy characteristic of demand systems is articulated through the Slutsky's [93] equation, which necessitates that the coefficients on prices for the estimated equations demonstrate symmetry to incorporate the axiom of rational choice within the model [89,90]. The Slutsky equation is formulated for each *i*-good as a combination of the substitution effect and the income effect[5]. Specifically, the equation differentiates the total impact of a price alteration into two components: the substitution effect reflects the change in demand quantities resulting from alterations in the relative price of a good while the consumer's purchasing power remains unchanged, and the income effect represents the variation in quantity demanded due to shifts in the consumer's purchasing power while keeping the relative price constant. Thus, the Slutsky equation enables us to analyze the repercussions of price fluctuations on consumer behavior and reveals the adjustments consumers make to their consumption patterns in response to external influences.

Utilizing the Hicksian framework to ascertain substitution elasticities and employing the Slutsky equation to derive elasticities concerning both income and price allows us to forego the necessity of imposing the symmetry condition ($\lambda_{ij} \neq \lambda_{ji}$). This approach enables an examination of the impact that unobstructed price alterations exert on the budget share allocated to each good. Given that consumer rationality is inherently flawed [94], their decision-making is influenced by additional variables, such as marketing expenditures, which can elevate goods' prices, thereby enabling firms to command premium pricing. The Hicksian framework emphasizes concave utility curves in relation to prices as a fundamental principle of consumer theory, diverging from the Marshallian perspective, which centers on income. These empirical premises are crucial when analyzing three distinct goods and are incorporated into our model.

According to Engel's law, a good exhibiting an income elasticity (ε_i) within the (0;1) range experiences a decrease in budget share as income increases, categorizing it as an inelastic good. Conversely, a good with an ε_i exceeding one commands a greater budget share, thus being classified as elastic. Furthermore, goods characterized by an ε_i in the (0;1) interval are regarded as necessities, while those with an ε_i above one are identified as luxuries [41]. This indicates that the demand for a good may increase either less or more than proportionally in response to income variations, leading to a reduction in the budget share for the former and an escalation for the latter. In modeling contexts, the β_i parameter is employed to discern whether goods fall into the categories of luxury or necessity. We have calculated the income elasticity (ε_i) in the following way (2):

$$\varepsilon_i = 1 + \frac{\beta_i}{w_i} \tag{2}$$

with, $\varepsilon_i < 1$ if goods are necessities and $\varepsilon_i > 1$ if goods are luxuries. However, ε_i is not restricted to only positive values. Therefore, $\varepsilon_i < 0$ implies that the *i*-good is inferior—i.e., a Giffen good—which leads to an increase in demand as the price of the good increases. In this sense, our goods are normal (ordinary), and they have no negative income elasticity.

In our model, the parameter λ_{ij} elucidates the influence of Hicksian price elasticity (h_{ij}) on the allocation of budget shares for consumption. This parameter signifies the extent of substitutability or complementarity between two goods. Specifically, when the goods exhibit complementary attributes, the demand for one good diminishes in response to an increase in the price of the other. Conversely, if the goods are considered substitutes, an increase in the price of one good typically leads to a rise in demand for the other [41]. Calculations of Hicksian price elasticities, commonly known as compensated price elasticities, have been executed through several methodologies (3). Therefore, the net substitution effect has been calculated as a difference (4):

$$h_{ij} = \frac{\lambda_{ij}}{w_i} + w_j - \delta_{ij};\ \delta_{ij} = 0|i \neq j, 1|i = j \tag{3}$$

$$\Delta h = h_{ji} - h_{ij} \tag{4}$$

with, $h_{ij} < 0$, goods are complementary; otherwise, if $h_{ij} > 0$, goods are rival or replaceable. Finally, for the three categories of goods, we have calculated the Marshallian price elasticity (η_{ij}), also known as the uncompensated price elasticity, by using the Slutsky equation to make a comparison (5). The marginal budget share (w_i^m) for each category of commodities has also been determined as shown in Equation (6):

$$n_{ij} = h_{ij} - \varepsilon_i w_j \tag{5}$$

$$w_i^m = \varepsilon_i w_j \tag{6}$$

4.1. Materials, methods, and instruments

The time-series data pertinent to the analysis spanning from 2011 to 2020 is accessible within the I.Stat dataset[6]. This dataset encompasses information on commodities, specifically in the categories of industry and construction/production/industrial production volume relating to fruit and vegetable juices and beverages, alongside consumer price index data categorized under Prices/Nic-annual average.

To mitigate potential challenges associated with collinearity and heteroscedasticity, we applied the Seemingly Unrelated Regressions (SUR) approach as proposed by Zellner [95] for estimating model parameters. The parameter estimation detailed herein was consistently conducted using the Gretl software. Although these estimated parameters lack direct interpretive value, they are instrumental in deriving the corresponding elasticities.

The SUR methodology is notably efficient in instances where covariance is evident and yields consistent parameter estimates. Moreover, this technique emphasizes the necessity to acknowledge the interdependencies among correlated commodities.

Table 5 presents a systematic aggregation of goods categorized appropriately. Meanwhile, **Table 6** includes both the descriptive statistics regarding the utilized variables and their statistical interrelations. The correlation analysis provided substantiates the choice of the SUR approach adopted in this study. While not all observed correlations hold statistical significance, they nonetheless warrant consideration. Specifically, there exists a significant correlation between the consumed budget share and the income allocated to the same commodity. The qualitative aspect of the data analysis is augmented by incorporating the operative volumes across the three markets, along with consumer price indices and average per-liter prices throughout the designated timeframe, as illustrated in **Figure 2**.

Table 5. Disaggregated goods in commodity categories and their ATECO identification codes.

Goods	Commodities and codes
Bottled waters [BW]	Bottled water included natural, artificial, mineral, carbonated, without sweetening and flavoring additives (11.07.11.30-50)
Soft-drinks [SD]	Seltzer water (11.07.19.32) Tonic water (11.07.19.33) Orange soda (11.07.19.34) Lemon soda (11.07.19.35) Citric soda (11.07.19.36) Chinotto soda (11.07.19.37) Grapefruit and pineapple soda (11.07.19.38) Spume soda (11.07.19.39) Other non-alcoholic sodas (11.07.19.40) Carbonated soda (11.07.19.41) Cokes (11.07.19.52)
Juices [JC]	Tomato juice (10.32.11.00) Orange juice (10.32.12.10-20-30) Grapefruit and pomelo juice (10.32.13.00) Pineapple juice (10.32.14.00) Grape juice (10.32.15.00) Apple juice (10.32.16.00) Mixed fruit and vegetable juice (10.32.17.00) Other fruit and vegetable juices (10.32.19.10-20-30)

Source: Our elaboration from the I.Stat dataset.

Table 6. Main descriptive statistics of variables and their correlations.

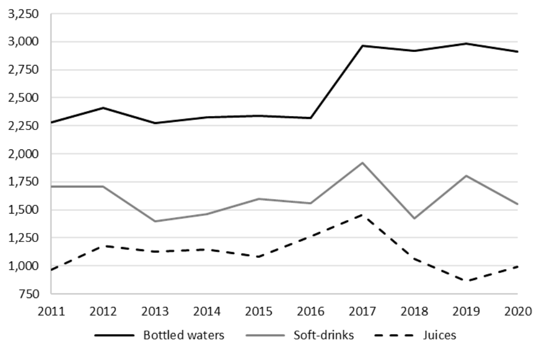
	w^{BW}	w^{SD}	w^{JC}	$\ln p^{BW}$	$\ln p^{SD}$	$\ln p^{JC}$	ln BW	ln SD	ln JC	ln Y/P
μ	0.483	0.311	0.206	4.626	4.650	4.629	14.738	14.295	13.879	10.843
σ	0.033	0.030	0.031	0.012	0.023	0.017	0.129	0.101	0.182	0.083
min	0.451	0.263	0.153	4.605	4.605	4.605	14.578	14.148	13.528	10.741
Max	0.540	0.372	0.246	4.648	4.674	4.655	14.908	14.467	14.193	11.032
Scale	Share	Share	Share	Trend	Trend	Trend	€-millions	€-millions	€-millions	Share
	Pearson's Rho (ρ)									
w^{BW}	1.000									
w^{SD}	−0.564*	1.000								
w^{JC}	−0.755**	−0.115	1.000							
$\ln p^{BW}$	0.897***	−0.592*	−0.608*	1.000						
$\ln p^{SD}$	0.675**	−0.681**	−0.271	0.792***	1.000					
$\ln p^{JC}$	−0.581*	−0.151	0.819***	−0.373	0.134	1.000				

Table 6. (*Continued*).

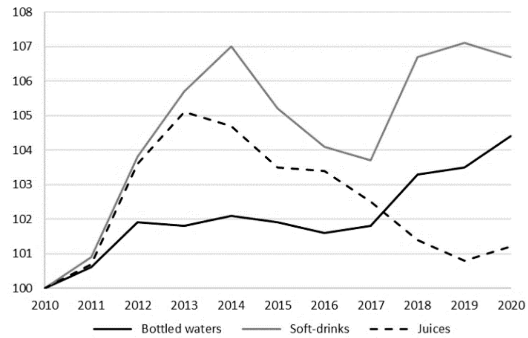
	w^{BW}	w^{SD}	w^{JC}	ln p^{BW}	ln p^{SD}	ln p^{JC}	ln BW	ln SD	ln JC	ln Y/P
	Pearson's Rho (ρ)									
ln BW	0.774***	−0.411	−0.604*	0.743**	0.416	−0.629*	1.000			
ln SD	−0.174	0.616*	−0.280	−0.149	−0.448	−0.448	0.365	1.000		
ln JC	−0.571*	−0.198	0.844***	−0.411	−0.263	0.545	−0.131	0.099	1.000	
ln Y/P	0.230	−0.043	−0.242	0.246	−0.079	−0.481	0.791***	0.755**	0.308	1.000

Note: (***) significant for α = 0.01; (**) significant for α = 0.05; (*) significant for α = 0.10. Source: Our elaboration.

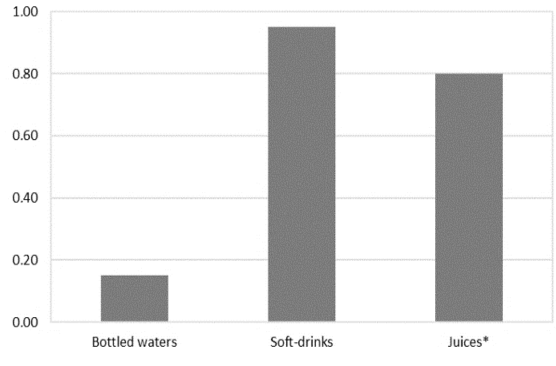
The application of logarithmic transformations addresses the issue of heteroscedasticity present in regression analysis. In essence, logarithmic transformations serve to linearize the relationships among variables, thereby enhancing interpretability. This facilitates the implementation of a linearly approximated variant of our demand system. Our model adopts a linear-logarithmic format, necessitating careful interpretation of the estimated coefficients in light of this transformation. It is crucial to note that while the coefficients cannot be interpreted directly as elasticities, these can be derived through appropriate conversions. Since the dependent variable has not undergone logarithmic transformation, the analysis adopts a linear-logarithmic regression model. This is feasible given that the dependent variable, expressed as a ratio, fluctuates within the [0,1] interval and maintains normal distribution alongside linearity.



(a)



(b)



(c)

Figure 2. (a) Operative volumes, €-million values; **(b)** consumer price indices, base = 2010; **(c)** per-liter middle prices.

Source: Our elaboration from the I.Stat dataset. (*) Commodity 10.32.12.10 (frozen orange juice) is not included.

Analysis of the correlograms illustrated in **Figure 3** reveals an observable persistence effect, albeit diminishing towards the end of the period under consideration. In summary, the visual-qualitative assessment of the correlogram representations suggests that the underlying processes can be regarded as weakly stationary with minimal persistence. Notably, however, this persistence is statistically insignificant within the short term. To further account for this observed persistence, one order of lags has been incorporated into the variables within the demand system.

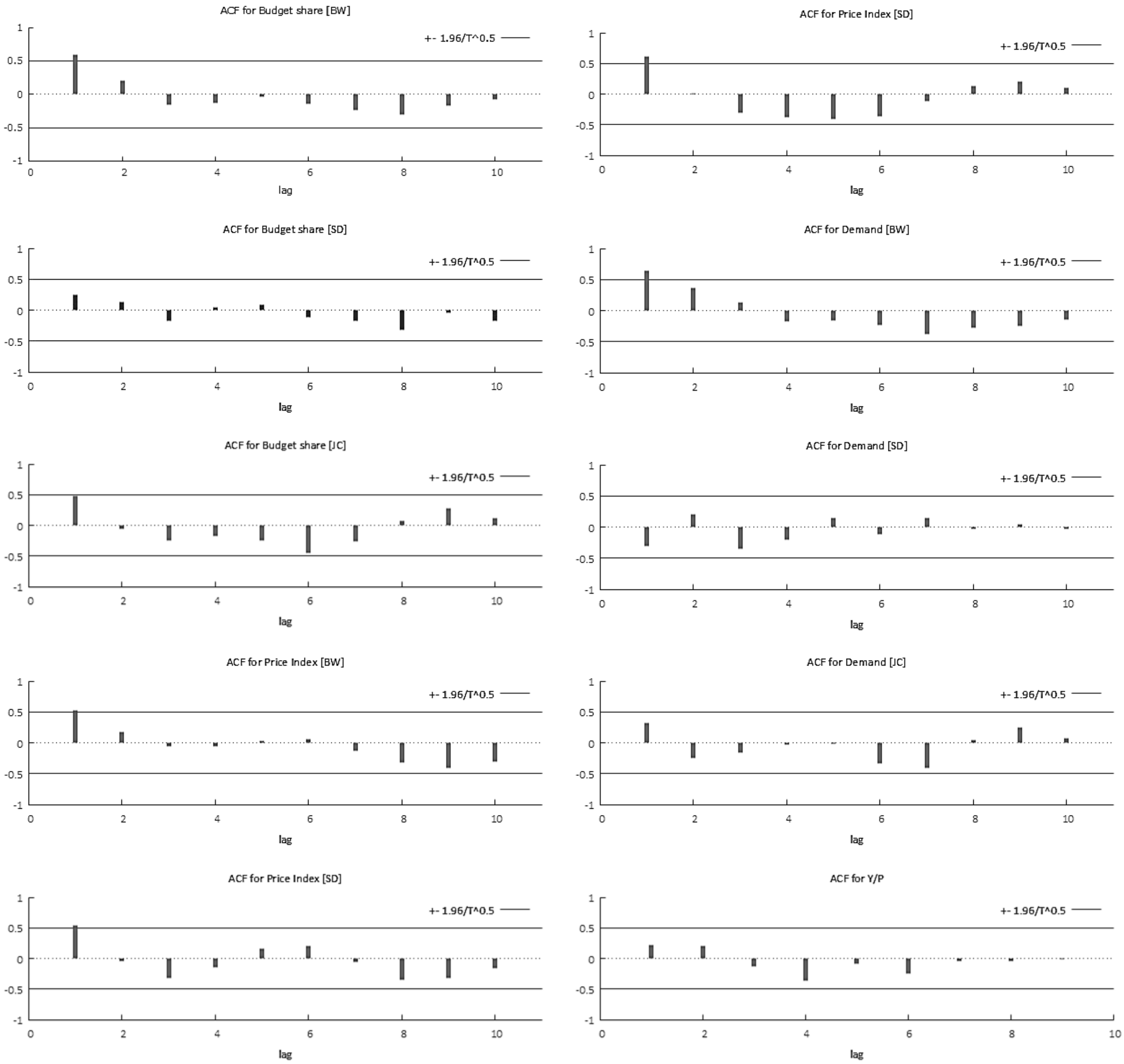


Figure 3. The correlograms view.

Source: Our elaboration from the I.Stat dataset.

4.2. Outcomes and discussion

Although parameters in the LA/AIDS model are essential in formulating price elasticities or checking the adding-up condition ($\Sigma\alpha_i = 1$; $\Sigma\beta_i = 0$), homogeneity ($\Sigma\lambda_{ij}$

= 0), and the symmetry condition ($\lambda_{ij} = \lambda_{ji}$), they have little informational value when taken individually.

It is worth noting the prevalence of consumption habits as measured by operative volumes with an order of lag (**Table 7**). Therefore, goods can be competitors or show a certain degree of substitution, and this consistency holds for all three categories of observed goods.

Table 7. The estimated LA/AIDS model constrained in adding-up and homogeneity conditions.

	w^{BW}	w^{SD}	w^{JC}	
ln BW_{t-1}	0.147*** (0.019)			
ln SD_{t-1}		−0.152*** (0.017)		
ln JC_{t-1}			0.004 (0.017)	
ln p^{BW}	0.085 (0.184)	1.627*** (0.203)	−1.061** (0.314)	
ln p^{SD}	0.970** (0.244)	−1.199** (0.245)	−0.782 (0.336)	
ln p^{JC}	−1.055** (0.188)	−0.428* (0.156)	1.843*** (0.250)	
ln Y/P	0.034 (0.026)	−0.038 (0.032)	0.004 (0.031)	
t_i	−0.003* (0.001)	−0.005** (0.001)	0.006* (0.002)	
α_i	−2.053** (0.394)	2.965*** (0.488)	0.088 (0.381)	
Standard error	0.006	0.005	0.009	
Adjusted-R^2	0.904	0.829	0.687	
Breusch-Pagan test (p-value)				12.989 (0.005)
Hansen-Sargan test (p-value)				11.802 (0.066)

Note: (***) significant for $\alpha = 0.01$; (**) significant for $\alpha = 0.05$; (*) significant for $\alpha = 0.10$. Source: Our elaboration.

The theory of demand posits that economic agents should not experience monetary illusion; thus, the demand for all three categories of goods should remain consistent, regardless of any abrupt changes in prices [89,90]. Consequently, it is necessary to implement the conditions pertaining to additivity and homogeneity during the estimation phase should these conditions not be inherently satisfied. Such constraints were indeed incorporated in the estimation process, as reflected in **Table 7**. Our analysis reveals that only the lagged values of two out of the three categories of non-alcoholic beverages, namely, bottled water and soft drinks, exhibit a statistically significant impact on their respective dependent variables. Furthermore, the influence of the time trend was also determined to be significant. These findings suggest that previous consumption behaviors exert a lasting influence on the demand for these beverages, although it is also possible for changes in consumption trends to occur over time.

Conversely, the lagged value pertaining to juices did not yield significant results, implying that historical consumption patterns do not maintain a lasting effect on demand for this particular category. Similarly, the time trend was not shown to significantly affect demand for juices either.

Lastly, should the Breusch-Pagan test indicate a correlation among the residuals of the equations, then the Seemingly Unrelated Regression (SUR) technique is deemed appropriate. The Hansen-Sargan test has also validated the model's correct specification. Given the brevity of the time series, the results may be understood as applicable primarily in the short term.

The aim of calculating elasticities and marginal budget shares is to comprehend the impact of price and income changes on consumer demand across the various goods and services encompassed within the demand system. Elasticities quantify consumer demand's sensitivity to fluctuations in prices or incomes related to a specific good or service. In contrast, marginal budget shares estimate the percentage of income that consumers allocate to a particular good or service in response to variations in income or price, using coefficients derived from the model. This data is invaluable for both leader firms and policymakers. For management, it assists in refining pricing strategies, whereas it equips policymakers to make informed decisions.

In the context of demand systems, elasticities differ according to the budget share equation. Therefore, we present the average elasticity calculated over the period for each set of goods. The elasticities determined for the three categories of goods are outlined in **Table 8**.

Table 8. The computed elasticities and marginal budget shares.

	Elasticities			**Net substitution effect**	**Marginal budget shares**
	Consumed income	**Hicksian**	**Marshallian**		
BW ↔ BW	1.070	–1.308	–1.825		0.519
SD ↔ SD	0.874	–5.240	–5.511		0.266
JC ↔ JC	1.021	7.531	7.320		0.215
BW ↔ JC		–2.389	–2.610		
BW ↔ SD		1.697	1.364		
SD ↔ JC		–1.617	–1.797		
SD ↔ BW		4.856	4.435	3.159	
JC ↔ BW		–5.515	–6.008	–3.126	
JC ↔ SD		–4.016	–4.333	–2.399	

Source: Our elaboration.

Income elasticity analysis reveals that the three products occupy a grey area between necessity and luxury classification. While bottled water and juices are more closely aligned with luxury items, soft drinks tend to be categorized as necessities. The elasticity associated with these goods is relatively low, indicating that their consumption demonstrates inelastic behavior concerning income fluctuations. Although household income availability can influence consumption elasticity, factors such as consumer habits and the marketing efforts undertaken by firms to enhance sales also play a significant role.

Demand theory posits that the own price elasticity should exhibit a negative value. Specifically, both bottled water and soft drinks display inelastic own-price elasticities, which aligns with established consumer demand theory and the principle of rational expectations.

In the case of juices, there exists a positive price elasticity, which could be perceived as a contradiction to conventional demand theory unless analyzed within the context of the Hicksian framework. This positive elasticity can be associated with the upscale nature of juices, characterizing them as luxury items. Consequently, the demand for juices displays a heightened sensitivity to shifts in pricing and income levels.

Thus, a positive price elasticity implies that an increase in the product's price results in a decrease in demand. It has been established that while demand for bottled water tends to be inelastic, the demand for soft drinks and juices shows greater responsiveness to price and income changes. To effectively interpret cross-price elasticities, it is essential to examine the net substitution effect, which encompasses both substitution and income elasticities among the goods in question. Bottled water and soft drinks are confirmed as rival goods, and the observed net effect illustrates how variations in bottled water prices influence the budget shares allocated to soft drinks. Conversely, a negative net effect emerges between juices, bottled waters, and soft drinks, signifying that these products are complementary to one another, with a stronger relationship identified between juices and bottled waters.

In summary, our analysis of cross-price elasticities indicates that soft drinks and bottled waters are substitutable products, whereas juices and bottled waters maintain a complementary relationship concerning soft drinks. Moreover, the findings suggest that Marshallian elasticities align closely with Hicksian ones, and marginal budget shares illustrate that bottled water remains the most frequently consumed among the three products, succeeded by soft drinks and juices.

4.3. Interpretative summary of results

Bottled water and soft drinks show inelastic own price elasticities, aligning with the rational expectations in consumer demand theory. However, products examined lie between necessities and luxuries. Juices and bottled water lean towards luxury. Soft drinks lean towards necessity. Income and price elasticities are relatively low, indicating general inelasticity in demand. Positive price elasticity of juices implies potential luxury perception or Hicksian substitution effects. Based on cross-price elasticities, bottled water and soft drinks are substitutes. Juices and both other categories are complementary goods, especially with bottled water.

The statistical significance of lagged values for bottled water and soft drinks suggests persistent habits or well-established consumption. Meanwhile, lagged consumption for juices suggests less predictable or consistent consumer behavior. Positive own price elasticity of juices indicates luxury or prestige-driven consumption, possibly skewed by marketing or niche positioning.

5. Conclusions

5.1. Contribution and concluding remarks

This study, aimed at elucidating the long-term market dynamics influencing consumption patterns in Italy, has employed a demand system to examine the short-term trends in the Italian non-alcoholic beverage industry. In a novel approach, the research synthesized two quantitative methodologies, integrating a dynamic equation within both the Weighted-OLS (WLS) models and the Linear Approximate Almost Ideal Demand System (LA/AIDS). This allowed for the estimation of coefficients, facilitating the direct calculation of price and income elasticity. Additionally, marginal budget shares were derived from the analysis.

The consumption patterns of bottled water in Italy, dissected through the lens of the four macro-markets identified by ISTAT (northwestern, northeastern, central, and southern regions, including the two islands), exhibit a strong and significant positive correlation with operative volumes reflecting one period of lag and are additionally influenced by fluctuations in the intermediate temperature trends during the analyzed period [88]. Firms in this industry may seek to employ competitive pricing strategies as a means of enhancing their operative volumes and, consequently, profitability. Nevertheless, consumers are often willing to pay premium prices for bottled water, a phenomenon that can be attributed to effective brand positioning tactics employed by firms through various elements of the marketing mix, which aim to maximize the breadth of product lines offered [5,39,40].

Consumption of bottled water should not be solely associated with personal preference, given that water represents an essential resource for all living organisms. However, in numerous Western economies, including those in the Westernized world, it is commonly packaged in bottles. As a result, consumer choices increasingly reflect individual preferences and consumption habits, particularly in mature markets such as Italy, where limited discourse exists surrounding the comparative quality of bottled water versus tap water. Consequently, acquiring bottled water has evolved into a habitual behavior or lifestyle choice for many individuals, who perceive this water as safer, healthier, or of superior quality [96].

The findings of this analysis further reveal that the income elasticity of the three product categories is positive, categorizing them as normal goods that exist at the threshold between necessity and luxury. Specifically, bottled water and juices are regarded as luxury goods, while soft drinks tend to be viewed more as necessities. Moreover, soft drinks and bottled water exhibit price elasticity, whereas juices alongside bottled water or soft drinks display price inelasticity. The evidence suggests that bottled water is the most extensively consumed product, followed by soft drinks and juices.

Factors influencing the consumption of items related to the bottled water industry may include public health considerations, which could affect production levels, and elements of the marketing mix. Our research indicates that the production of soft drinks and juices hovers at the intersection of necessity and luxury goods based on their income elasticity. Furthermore, a negative correlation has been identified between past consumption behaviors and operative volumes, reflecting one period of lag.

This may imply, for example, the presence of a specific dependency among consumers on sweeteners, which existing literature links to the perceived health benefits of various food products [97]. This situation could indicate that, in subsequent phases, individuals who once frequently purchased soft drinks or juices might choose to curtail their intake or modify their dietary preferences by gravitating towards bottled water, a choice positively correlated with their prior consumption patterns. Consequently, consumers can be influenced to make purchasing decisions through emotional engagement, as firms allocate resources to advertising campaigns and marketing strategies [42].

Research has also established a significant link between the intake of sugary beverages and various health hazards [98,99]. As a result, policymakers may contemplate the implementation of a taxation framework aimed at curbing the consumption of such products, particularly within populations of lower and middle incomes or among individuals lacking adequate awareness of health risks, as these groups tend to be more sensitive to fluctuations in pricing. Alternatively, policymakers might opt to pursue institutional outreach efforts designed to promote healthier dietary practices or, at the very least, disseminate information about nutritional choices, with the overarching goal of achieving sustainable reductions in long-term public health expenditures [100–103].

5.2. Policy implications

Bottlers have the opportunity to utilize any available excess production capacity for the manufacture of soft drinks and flavored water, contingent upon the presence of adequate operational flexibility in their facilities that allows them to capitalize on economies of scope. This scenario raises a dimensional contention regarding the delineation of the industry since the ATECO classification encompasses categories of goods that exhibit limited interchangeability from both demand and supply perspectives, thus highlighting the ongoing challenges associated with industry and market demarcation.

The capacity to operate flexible manufacturing plants and to leverage economies of scope does not suffice for the inclusion of dissimilar products within the same market or industry, as exemplified by soft drinks. The pronounced horizontal differentiation among products further elucidates that consumer flexibility cannot serve as a valid criterion for a broad-based definition of the industry and market. Consequently, there is a growing relevance in the legal and economic discourse surrounding competitive protection issues. It is imperative that the definition of an industry be articulated by the regulatory body responsible for competition oversight, in addition to traditional definitions adapted from industrial economics. This articulation can be instrumental in identifying scenarios where there is a potential for market power abuse by incumbent firms. This consideration may equally pertain to industries organized into conglomerates and misleading classifications.

In economics, a good that is both non-exclusive and competitive in nature is deemed a common good due to its availability to all individuals. This classification gives rise to a variety of governance-related challenges [104]. For instance, in Italy, it could be critical to establish a comprehensive policy framework aimed at safeguarding environmental and territorial sustainability, as has been initiated in various other regions globally [105–108]. Policymakers should consider the potential for a reduction in greenhouse gas emissions associated with accelerated development rates through the implementation of active demand substitution policies aimed at transforming consumption habits over time [109–111].

Although quantifying the effects of these transformations poses challenges, it is plausible that both a decline in water availability and a surge in demand due to heightened consumption may occur on a local scale [4,112,113]. Thus, the formulation of coordinated industrial policies to alleviate climate-related impacts and minimize resource wastage becomes imperative [114–118]. It may also be essential to evaluate the quality of bottled water in Italy and investigate the potential health risks arising from hazardous substances that may leach from plastic containers into the water supply [119,120]. To elaborate, risk assessment constitutes a methodical approach aimed at recognizing these hazardous elements [121–124].

Given the market's significant dependence on global issues, numerous firms within the non-alcoholic beverages industry have enhanced the appeal of their products through innovative packaging designs, transforming traditional glass bottles into aesthetic elements. The conventional glass bottle, historically considered a "void-to-return" that larger corporations could sometimes produce by extending their production processes, has increasingly been supplanted by cost-effective containers sourced externally while maintaining product integrity [16,18]. This transition has enabled firms to substantially decrease production costs, thereby increasing profit margins through a more economical distribution process facilitated by the employment of polymer materials in packaging.

Nevertheless, contemporary firms are now compelled to intensify their efforts towards employing biodegradable materials in their packaging methodologies to enhance environmental sustainability and contain the risk of contamination by per- and polyfluoroalkyl substances (PFAS) or other contaminants, even during the manufacturing process [48,125]. In this regard, trade associations uniting the main Italian firms in the industry may play a pivotal role in raising awareness and adequately informing consumers [12,126]. Specifically, in industries where the incorporation of recycled polymers would mitigate greenhouse gas emissions, which have contributed to the escalation of global temperatures over recent decades.

5.3. Limitations and suggestions

This research has not incorporated household socio-economic characteristics and tourist dynamics as additional explanatory factors in the modelling process. Integrating these elements into the determinants could offer insights into variations in consumption patterns. Additionally, employing panel data analysis that accounts for data heterogeneity may provide beneficial insights. Alternative system models could also be applied to reflect the non-linear nature of demand more accurately when a complex relationship exists between expenditure shares and budgetary allocations [127,128]. Such models would facilitate a broader inclusion of control variables than is feasible with the LA/AIDS framework. To our knowledge, no prior studies have examined the demand for bottled water, soft drinks, and juices in Italy utilizing the QAIDS model or semi-flexible AIDS during the 2011–2020 timeframe. Consequently, an avenue for future research could involve the application of this demand system functional form within the temporal scope we've analyzed.

Another promising avenue for further investigation could involve exploring the implications of imperfect competition within the market. Such a condition could adversely affect industry efficiency and escalate costs for firms due to market concentration, as firms operating in a concentrated environment often wield significant market power and secure substantial profits without substantial incentives for enhancing operational efficiency.

Moreover, subsequent research should consistently take into account the potential for poor separability among goods. The analysis could be broadened to include enhanced waters within the demand framework. For example, distinguishing between flavored and functional waters could yield interesting insights; however, this differentiation is constrained by the limitations of the ISTAT dataset, despite relevant data and information being available through the Beverfood annual compendiums concerning Italy's non-alcoholic beverage industry.

These newly introduced bottled waters are categorized alongside other soft drinks, often commanding a premium price. They thus exemplify a differentiation strategy or a related diversification strategy adopted by bottlers. The rapid surge in their consumption is tied to marketing efforts by firms aiming to leverage the value of their brands and product labels. Indeed, these marketing strategies frequently emphasize the organoleptic qualities and health benefits of these waters, which consumers perceive as superior.

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Notes

1 Drinking water is defined as water that is sourced from springs, subsequently bottled, and marketed in accordance with Legislative Decree 105/92, along with its later amendments, notably Legislative Decree 339/99, Legislative Decree 176/11, and the regulations established by the Ministry of Health pertaining to food safety. The industry operates within a multifaceted and fragmented regulatory framework designed to safeguard consumer interests, a framework that has undergone numerous revisions across various historical contexts [6]. Consequently, the legal characterization of this commodity holds significant relevance within the realm of public law economics, as drinking water constitutes a common resource [129,130].

2 The CR4 index is 60% in the juice industry, rising up to 80% when the top-eight groups are considered: Italy Conserve (30%), Amalfi Holding (11%), Lactalis (10%), Zuegg (9%), Refresco Italy (6%), Fruttagel (6%), Rauch Italy (4%), and Pfanner Italy (4%). Furthermore, the groups can add the shares held to those of other related industries, above all Refresco Italy and San Benedetto Mineral Water [34].

3 The code ATECO for the bottled water industry identification is C.11.07.00. The ATECO code is a classification system for industries approved by the Italian Statistical Institute (ISTAT). It is a standardized classification for firms based on their core

business in the industry. It makes it easy to collect and compare data across different industries. The letters identify the macro-industry, while the numbers clarify the different degrees of detail of the subcategories.

4 It was calculated as follows:

$$H_\theta = \frac{1}{N_i N_j} \sum_{i=1}^{N} \sum_{j=1}^{N} \left| \frac{\mu_\theta - \theta_{ij}}{\mu_\theta} \right|.$$

5 Theoretically, the Slutsky equation highlights the decomposition of the change in demand for i-good in response to a change in the price of j-good, and can be traced back to elasticities in the following way [41]:

$$\frac{\delta x_i(p,w)}{\delta p_j} = \frac{\delta x_i(p,u)}{\delta p_j} - \frac{\delta x_i(p,w)}{\delta w} x_j(p,w) \quad \Leftrightarrow \quad \eta_{ij} = h_{ij} - \varepsilon_i w_j.$$

on the left-hand side of the equation, x_i (p, w) is the Marshallian demand, while, on the right-hand side of the equation, x_i (p, w) is the Hicksian demand, and x_j (p, w) is the quantity demanded of the j-good. Then, the corresponding price levels and budget shares are p and w, respectively. In other words, the right-hand side of the equation represents the change in demand for the i-good, maximizing the given utility function at the fixed u-level, minus the change in demand for the i-good when w changes, multiplied by the quantity demanded of the j-good. The first term on the right-hand side of the equation is the substitution effect, and the second term is the income effect. The substitution effect is caused by the effect of the price change of the same good—i.e., when the price of a good changes and becomes cheaper, if its consumption is unchanged, there is more income that may be spent on a combination of more goods or on each of them. While the income effect is caused by the income previously freed up. Therefore, the consumer’s purchasing power increases as a result of a price decrease, allowing the purchase of better goods or more of the same good, depending on whether these are normal (ordinary) goods or inferior (Giffen) goods.

6 The ATECO codes for the identification of the fruit and vegetable juice industry are C.10.32.00, while the soft drink industry is merged with the bottled water industry (C.11.07.00).

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