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Food Safety and Quality in Connection with the Change of Consumer Choice in Czechia (a Case Study)

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Abstract: The purpose of this study is to express changes in consumer preferences for certain food products due to the income growth of the population, and to specify the way producers or retailers of these commodities respond to the changes in customer choices. The methodology of this study is based on comparing the economic model of consumer behavior in the market to the analysis of demand elasticity, together with its practical application to food products of the same brand offered by multinational chains in Czechia and Germany. The study presents a new survey, including a comparison of the quality and safety of food products offered by retail chains in Czechia and Germany, and a comparison with similar bio-quality products offered by Czech farmers in their shops or at farmers' markets. As the comparison indicates, unless multinational producers change their current behavior, consumers will prefer purchasing products from Czech producers, including products offered at farmers' markets, and shop in neighboring countries where higher-quality original products may be found.

Keywords: consumer choice; Czechia; food retailing; food safety; food quality; retail chain; self-sufficiency

Citation: Severová, L.; Svoboda, R.; Šrédl, K.; Prášilová, M.; Soukup, A.; Kopecká, L.; Dvořák, M. Food Safety and Quality in Connection with the Change of Consumer Choice in Czechia (a Case Study). *Sustainability* **2021**, *13*, 6505. https://doi.org/10.3390/su13116505

Academic Editor: Matthew Kelly

Received: 30 April 2021
Accepted: 4 June 2021
Published: 7 June 2021

1. Introduction

Before 2020, Czechia and some other European countries have undergone economic recovery, demonstrated by economic growth. In 2019, the year-on-year growth of the Czech economy reached 2.3% (GDP), which has led, among other things, to an increase in the average wage [1]. This is leading to changes in consumer preferences in the food commodities market. Not only do people wish to buy common and cheap products that satisfy their basic needs, but they are also beginning to include higher-quality products in their shopping baskets. This change in consumer preferences results in a stronger desire of the population for better knowledge of the quality and safety of purchased products. "Transnational food retailers expanded to middle-income countries over recent decades responding to supply and demand" [2]. Given the free movement of people within the EU, Czech people are able to compare similar products offered in the same retail chains in Western Europe and Czechia [3]. Although these products often seem to be identical, making the consumers believe they are buying products of the same quality, the reality is different.

The possibility of conducting a case study focused on the quality and safety of food in the Czech Republic (in relation to other EU countries) and the possibility of increasing the level of these food properties represent research gaps.

Conducting a comparison of the quality of identical products sold in the Czech Republic and Germany and describing the conditions of food storage in retail chains will contribute to a more detailed knowledge of the issue.

This article describes changes in consumer preferences regarding the purchase of food products due to the income growth of the population, and to specify the ways that producers or retailers of these commodities respond to the changes in customer choices.

2. Literature Review

In many developed countries, the prevalence of food insecurity has increased in recent years [4]. Food safety and, above all, quality, are still current and frequently discussed topics. "Food safety incidents are an important issue in every country and frequently make headlines around the world" [5]. "Safe food" means food that does not have a harmful effect on the health of consumers and is not unsuitable for human consumption. Food safety is expected and required automatically by the consumer, and is also prescribed by legislation and must always be ensured. "The food safety warranty is a fundamental principle of international trade" [6].

Many countries have established new institutions, standards, and methods for regulating food safety, and have increased their investments in hazard control systems; for example, good agricultural practices (GAP), good manufacturing practices (GMP), and hazard analysis and critical control point (HACCP) facilities [7]. Weng and Neethirajan [8] state that "the development of analytical methods and techniques to ensure food safety is thriving, particularly as consumers have increasing concerns regarding the content and safety of their food supply".

"Safety and quality examination is an important step in the food production process, as many factors, such as stricter regulatory agency rules, customer demand for safer and higher-quality foods, and increasing outbreaks of foodborne illness, have been continuously challenging food inspection technologies" [9].

"Food safety concerns have existed for a long time, as millions of people across the globe suffer from foodborne diseases every year. Contamination of food primarily owing to limited knowledge of food safety practices increases the risk of food borne illnesses" [10]. Burdock and Wang [11] state that "hazard determination is a critical starting point for determining the risks involved in the use of any substance in food".

"Foodborne illnesses are a burden to public health globally and to national economies" [12]. Baur et al. [13] say that "in an intensifying climate of scrutiny over food safety, the food industry is turning to "food safety culture" as a one-size-fits-all solution to protect both consumers and companies".

The term "food quality" includes a whole set of partial aspects (parameters) that are related or linked to each other. Examples include nutritional, hygienic, sensory, and technological aspects. The perception of food quality is largely dependent on subjective consumer assessment and is related to their perception of quality parameters and previous experience. For this reason, it cannot automatically be assumed that safe food will always be perceived as good by the consumer [14].

However, in developed countries, including the Czech Republic, the quality parameters for a particular foodstuff can be determined by legislation. For example, a product with a protected geographical indication, such as Pardubice gingerbread, or meat content for some meat products or by various industry standards that are not legally or otherwise binding, but, on the other hand, reflect habits and perceptions of what is considered to be good for consumers in a particular culture (society) and at a given time. "Nowadays, regional product labeling is a tool being used worldwide, mainly by the food, helping to make a food production of small and middle-sized regional and local producers and farmers more visible among the consumers" [15]. "A few studies have also investigated consumers' perceptions of food safety regarding products in farmers' markets, or their impact on consumers' purchasing behavior" [16]. Quality parameters also need not be

defined in writing, and their value may only reflect the perception of the quality of the product among the majority of the consumer population.

Whether the end product is perceived by the consumer as being of good quality is largely determined by the manufacturer's recipe, which determines the ratio, type, and quality of the raw materials used and the method of processing. The specific ingredients of the recipe depend on a number of factors, including the production price of the final product. Regardless of how the quality of the food is perceived by the consumer, it is essential that the quality and raw materials remain as similar as possible over time [14]. However, consumers are currently more interested in minimally processed food products without additives, with improved safety and increased shelf-life [17–19].

Sustainable development is one of the main objectives of the European Union. Sustainable economic development is also one of the main objectives of the EU's common agricultural policy [20]. According to its principles, the economic aspect of development should perceive society and the natural environment not as its inhibitors but rather as stimulants [21,22]. Prus [22] further adds that sustainable development in agriculture means programming farming production to make reasonable use of natural resources and the environment. It should also provide sufficient amounts of food while maintaining its high quality. "Modern agriculture provides the potential for sustainable feeding of the world's increasing population" [23].

3. Materials and Methods

The theoretical basis of the analysis is made up of the best-known microeconomic models dealing with consumer behavior and demand elasticity, created from the works of Varian [24] and Schiller [25]. An important source for the article's elaboration was the publication by Gravelle and Rees [26].

The methodology of the following study is based on comparing the theoretical model of consumer behavior in the market to the analysis of demand elasticity together with its practical application to products of the same brand offered by multinational chains in Czechia and in Germany. Using the comparison results, a change in consumer behavior regarding the purchase of foods in Czechia may be predicted.

In order to verify the current state of the safety and quality of food consumed in Czechia, the following hypothesis was formulated:

> *"In Czechia, safe and high-quality food is usually sold, not only of Czech but also of foreign production; this is guaranteed by the constant control of the food market by state institutions. However, there may be lower quality imported food or, in some cases, improperly stored food."*

Our own research methodology consisted of the following:

- In order to verify the validity of the hypothesis, the results of food controls carried out by state institutions of the Czech Republic and EU were gathered.
- In addition, our own research on the quality and safety of fruit sold in multinational retail chains in Czechia was carried out. The research was carried out on the same day every week in August 2019 in two supermarkets of the multinational retail chain Kaufland in Prague. This eliminated the random element of research at stores.
- To verify the opinions of future managers in agriculture and the food industry on the quality of food sold in the Czech Republic, a research survey was conducted among first-year master's degree students in Business and Economics (BAE) and Business and administration (BAA) at Faculty of Economics and Management at the Czech University of Life Sciences in Prague (FEM CULS in Prague). The questionnaire was filled in by 242 students who were present in class in the first week of February 2020. It was thus a representative sample of students in the monitored fields of economics at the Czech University of Life Sciences in Prague.

3.1. Methodology of Evaluation of Questionnaire Survey

The following procedure was used to evaluate the authors' own research on the quality of food, which was conducted among students in the Czech University of Life Sciences in Prague (CULS) in 2020 (Section 4.6). In the data obtained, processing, descriptive statistical methods have been employed and to establish the relationships between the A and B variables, the χ^2 independence test has been used, with the test criterion [27]:

$$\chi^2 = \sum_{i=1}^{r} \sum_{j=1}^{s} \frac{\left(n_{ij} - n'_{ij}\right)^2}{n'_{ij}} \quad (1)$$

where

n_{ij}: the empirical frequency.
n'_{ij}: the theoretical frequency.
$i = 1, r$, where r is the number of the A variable varieties.
$j = 1, s$, where s is the number of the B variable varieties.

The χ^2 test criterion is governed by χ^2 distribution with $[(r - 1)(s - 1)]$ degrees of freedom.

The strength of the relationship between the A and B variables has been established using the Cramér contingency coefficient V:

$$V = \sqrt{\frac{\chi^2}{n(q-1)}} \quad (2)$$

where n is the size of the sample, $q = min\ (r, s)$, $V \in <0; 1>$.

3.2. Consumer Choice Model

The generally known basic model of Pareto efficiency applied to a simple consumer choice in the ordinal theory of utility [25] may be used as the basis for the creation of a mathematical model with broader opportunities for analyzing consumer choices.

Let us assume that the consumer uses two products and their income spent on the purchase of the products equals Y (see Figure 1).

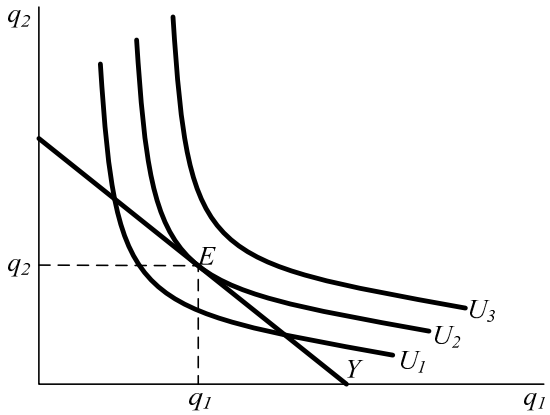

Figure 1. Indifference curves and the efficiency point in a two-product model [26].

The indifference curve expresses consumer (user) preferences regarding the two products. The further from the origin the indifference curve lies, the higher the level of total utility it expresses. The consumer would, therefore, prefer the combination on a higher-situated curve to combinations lying along lower-situated indifference curves. The consumer's budget limitation is given by the y-axis. If the consumer spends all their income, divided into expenditure on both products, the selected combination must lie on

this line. Thus, point E is ideal for the consumer, representing the geometrical display of the highest attainable utility. There are numerous partial models of indifference analysis.

The following function of the total utility will be used.

$$U = (A - e \cdot q_1) \cdot q_1 + B \cdot q_2 \tag{3}$$

$$U = A \cdot q_1 + e \cdot q_1^2 + B \cdot q_2 \tag{4}$$

where

U: total utility ($U > 0$).
q_1: quantity of the first product consumed ($q_1 > 0$).
q_2: quantity of the second product consumed ($q_2 > 0$).
A, B, e: index of active assets at constant prices.
A: consumer preference parameter to the first product no. 1 ($A > 0$).
B: consumer preference parameter to the second product ($B > 0$).
e: consumer preference parameter to the first product no. 2 ($e > 0$).

If the common procedure of comparing the share of the marginal utility of both product and the share of their price together with the budget limitation equation is applied, the result is:

MU_1: marginal utility of the first product.
MU_2: marginal utility of the second product.
P_1: price per first product unit.
P_2: price per second product unit.

$$MU_1 = A - 2 \cdot e \cdot q_1 \tag{5}$$

$$MU_2 = B \tag{6}$$

$$Y = P_1 \cdot q_1 + P_2 \cdot q_2 \tag{7}$$

$$\frac{MU_1}{MU_2} = \frac{P_1}{P_2} \tag{8}$$

$$\frac{A - 2 \cdot e \cdot q_1}{B} = \frac{P_1}{P_2} \tag{9}$$

$$A \cdot P_2 - 2 \cdot e \cdot P_2 \cdot q_1 = B \cdot P_1 \tag{10}$$

$$P_1 = \frac{A \cdot P_2}{B} - \frac{+2 \cdot e \cdot P_2 \cdot q_1}{B} \tag{11}$$

If the relation is expressed for q_1:

$$q_1 = \frac{A}{2 \cdot e} - \frac{B \cdot P_1}{2 \cdot e \cdot P_2} \tag{12}$$

A simpler model will suffice for this purpose. Let us assume that the second product is a benchmark, the price of which will be constant over the given period, and the preference parameter B will not change. Thus, the following will hold true: $P_2 = 1$, $B = 1$. Relations (11) and (12) will then be:

$$P_1 = A - 2 \cdot e \cdot q_1 \tag{13}$$

$$q_1 = \frac{A}{2 \cdot e} - \frac{1}{2 \cdot e} \cdot P_1 \tag{14}$$

If the following is marked:

$$a = A \tag{15}$$

$$b = 2 \cdot e \tag{16}$$

Relations (11) and (12) will result in:

$$P_1 = A - b \cdot q_1 \tag{17}$$

$$q_1 = \frac{a}{b} - \frac{1}{b} \cdot P_1 \tag{18}$$

In this model, the optimal quantity q_1 does not respond to a possible change (increase) in the income Y. Income Y is not present in Equation (12), or (18). Let us only assume that:

$$Y \geq P_1 \cdot q_1 \tag{19}$$

thus, the given level of income Y exceeds the expenses on the first product.

3.3. Demand of Two Consumer Types

A simple expression of a linear function of demand has been obtained, where a is a level parameter and b is the demand function tendency.

Figure 2 shows consumer demand with a high parameter e (and thus also b) and a steeper slope function. Figure 3 shows consumer demand with a lower e and a gentler slope function.

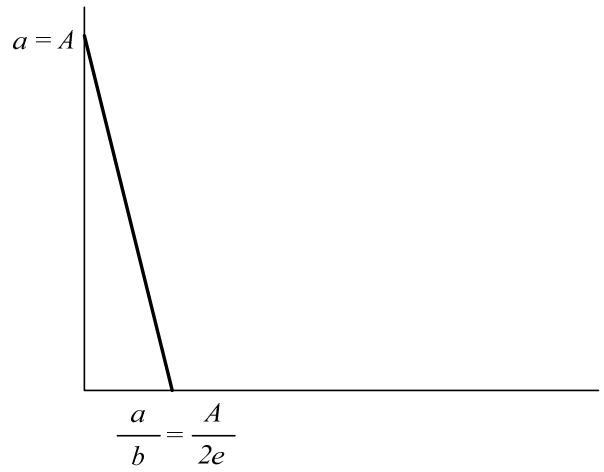

Figure 2. Consumer demand with a high parameter e (own processing).

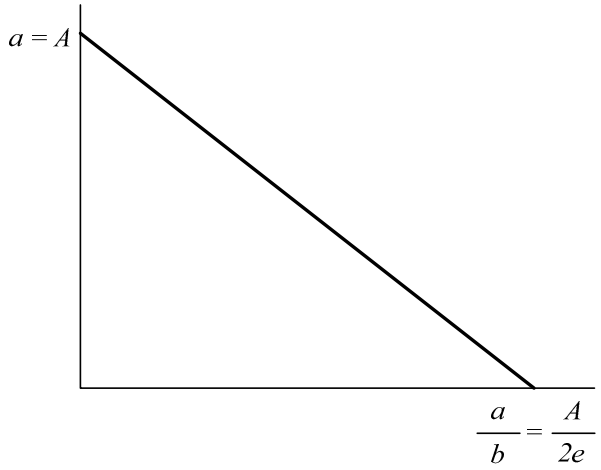

Figure 3. Consumer demand with a low parameter e (own processing).

Relations (17) and (18) express the function of the demand for the first product, provided that other quantities, except for P_1 and q_1, are considered to be constants. Let us

consider two consumers whose preferences vary, resulting in the creation of two different functions of the demand for the first product on the market. Those can also be two groups of consumers, or consumers from two different countries.

Their preferences will be based on the function of the utility of type (3), but varying in parameter e. This will result in the formation of two functions of the demand with a varying parameter b; thus, with a different slope and, probably, price elasticity.

Using our model, we try to express the balance over a short time in a situation of monopolistic competition. Thus, the function of the demand (17) will also be the function of the average company revenue.

$$AR = a - b \cdot q_1 \tag{20}$$

The total revenue, TR, and marginal revenue, MR, functions can be derived from this relation.

$$TR = a \cdot q_1 - b \cdot q_1^2 \tag{21}$$

$$MR = a - 2 \cdot b \cdot q_1 \tag{22}$$

Let us assume that the producer's cost function will be:

$$TC = m + n \cdot q \tag{23}$$

where m and n are coefficients of a simple function of total costs.

Thus, the marginal costs function will be:

$$MC = n \tag{24}$$

The marginal costs are constant over a short time.

With a balance over a short time, the marginal revenue, MR, and marginal costs, MC, must be equal:

$$a - 2 \cdot b \cdot q_1 = n \tag{25}$$

The following will provide the equilibrium quantity of the first product:

$$q_1 = \frac{a - n}{2 \cdot b} \tag{26}$$

The equilibrium price level can be found from $P = AR$ by including q_1 in (18):

$$P_1 = \frac{a + n}{2} \tag{27}$$

Unlike the quantity q_1, the price level P_1 does not depend on the b or on the e parameter.

The application of this equilibrium model, over a short time, to the two given groups of consumers with different preferences, whose demand functions vary in parameter b, will result in the formation of equilibrium with the same equilibrium price, but a different quantity of the first product.

The figures show that the group of consumers with a lower b (or e) (see Figure 4) will, if the price is the same ($P_1 = P_1'$), demand more of certain products than the group of consumers with higher b (or e) (see Figure 5).

Lower elasticity may be assumed for a lower-quality product because its consumption is more of a need for consumers, while certain similarities with luxurious goods can be observed in a higher-quality product; thus, the price elasticity of the demand will be higher. Regarding these two types of consumers, each of them buys different goods at the same price. This is because of their different preferences. A possible application of the model is demonstrated in the following comparison of foods.

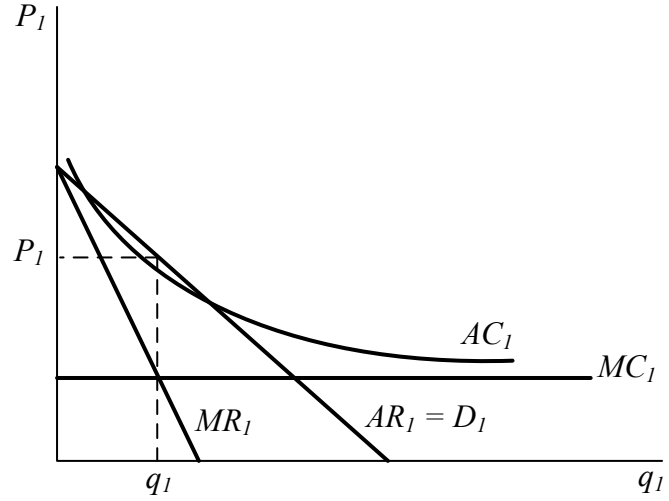

Figure 4. Consumer demand with a high parameter *b* (*e*) [26].

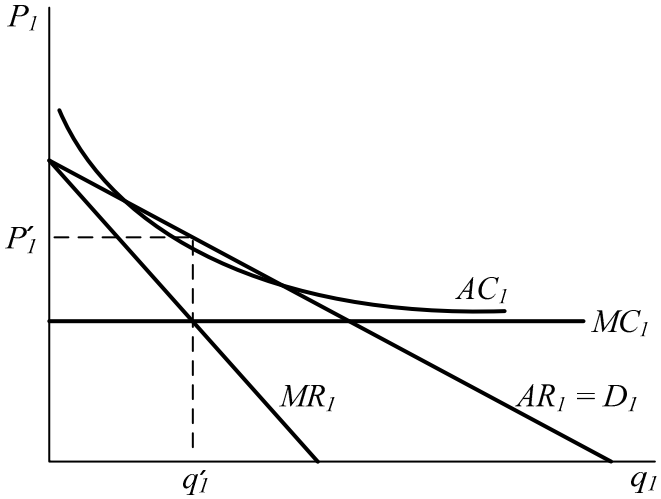

Figure 5. Consumer demand with a low parameter *b* (*e*) [26].

4. Results

4.1. Low Food Self-Sufficiency of Czechia as the Reason for Food Imports

Czechia is not close to food self-sufficiency for certain basic commodities—above all most processed animal products—but, on the contrary, continues to move away from it. For example, almost 50% of pork, 45% of poultry, over 30% of cheese and other dairy products, and as much as 70% of temperate zone fruits and vegetables are imported [1]. "Low food self-sufficiency is the reason for the long-term growth of Czech imports; the market price of agricultural products is determined by their import price" [28].

In the apple harvest, Czech fruit growers recorded a drop of about 40,000 tons in 2017 compared to the previous year. In Moravia, this was due to frosts, while in Bohemia it was due to hail that hit them in May and June. However, consumers were not influenced by the lower harvest of apples, as 50% of apples are imported to Czechia.

However, apples, one of the most important Czech fruits, are not the only fruit imported in bulk. According to a survey conducted by the agrarian chamber in all regions, an average of 55% of the products in supermarkets are Czech. In other countries, it is quite common that between 80 and 90% of the products in the shops are local, and only specialties are imported [29].

In Czechia, such sales of domestic food are also not possible because local farmers store fruit and vegetables poorly. Czech farmers are able to grow quality potatoes, but

they are not sufficiently technologically equipped to maintain their quality. They have a problem especially with out-of-season deliveries, that is, deliveries after the potatoes have been stored for three to four months. Consumer interest in Czech potatoes is steadily rising, but Czechia is not self-sufficient in the long term and about 30% of potatoes must be imported. Food producers are forced to buy crops from Italy, Germany, or Hungary due to the lack of Czech potatoes.

Unfortunately, this problem does not only concern potatoes, but all vegetables and fruits in general. Imported foodstuffs are also interesting for Czechia because they are often cheaper than domestic ones. It is also because foreign producers can benefit from hidden national subsidies.

Is it possible to reverse this trend so that Czechia can achieve self-sufficiency? According to the Czech Agrarian Chamber [29], a seemingly easy turn in the present trend, leading to greater food self-sufficiency (for example, in pork and poultry or fruits and vegetables) is, in fact, far from easy. Many areas formerly used for growing vegetables are now occupied by other crops; orchards have grown wild or been clear-felled, and animal husbandry facilities are in ruins or being used for other purposes. Building new, competitive halls for fattening poultry or pigs requires huge investments amounting to tens of millions of Czech crowns, which is utterly unaffordable for many agricultural companies, and thus cannot be realized without state support.

4.2. Food Consumption after the Expiration Date

As a recent survey by the Centre for Public Opinion Research shows, more than half of Czechs sometimes consume food after the end of the minimum shelf-life. Approximately 48% of people eat perishable foods such as dairy products or meat after their shelf-life has expired (i.e., after the "use by" date). The survey also showed that 86% of people consider food waste to be a problem, while for over 40% of people it is a societal issue. An estimated 25 kg of food is discarded per capita per year in Czechia. Respondents said they wanted to reduce food waste, most often for financial reasons. Each household spends an average of 22,400 crowns (USD 1037) a year per capita on food [30].

4.3. Comparing the Quality of Foods Offered by Retail Chains in Czechia and Germany

When shopping in supermarkets in Germany, Czech customers may feel at home. They like buying quality products from global brands, preferably at promotional prices. They can find products of the same names and almost identical packaging as in Czechia, with prices not varying much. However, the content is often different from what they know at home. "As consumer opinion is very important in determining the development strategy for the food industry, it seems justified to determine if the geographical region has an influence on consumer opinion" [31].

This has been proven by a survey comparing twenty-four food products from Czechia and Germany (offered by the same retail chains), carried out by the University of Chemistry and Technology in Prague, in cooperation with the Albert retail chain, on the initiative of MEP Olga Sehnalová (Czech Social Democratic Party). Almost one-third of the products differed in their composition and taste [32].

- For example, the Czech version of strawberry-flavored Activia yogurt was colored with a carrot and carmine concentrate, while the German version was colored with beetroot. The fat content was also different. Information on the packaging stated 2.7 g/100 g in the Czech version, but 2.8 g/100 g in the German version. However, tests detected 2.43 g/100 g in the Czech version and 2.93 g/100 g in the German version. Its manufacturer Danone declared that recipes may vary in individual countries. The fat content in the product depends on the fat content of the milk that the yogurt is made from. According to Danone, the milk fat content is influenced by the different feeds for cows and the different environments in which the cows are kept. The company defends itself by declaring that it aims to produce its products from local milk [33]. Differing fat content was also found in Rama. The Czech version had 60%, while

the German version 70%; according to the manufacturer, the difference results from different preferences in individual countries.

- Pepsi Cola was sweetened with glucose-fructose syrup in the Czech Republic, but with sugar in Germany. Similarly, ice tea was sweetened with sugar, fructose, and steviol glycosides in the Czech Republic, but only with sugar in Germany. Further, the Czech product contained 40% less tea extract. According to the manufacturer, the Czech product has lower sugar content and a lower energy value, which was the purpose [33].
- Iglo Fish Finger sellers in states west of the Czech Republic declare they contain 65 percent meat, which is 7 percent more than in eastern European countries. Analysis revealed that in the Czech Republic the actual meat content was 50.2%, while in Germany it was 63.8%. Yet the products were packed in the same plant. Moreover, according to the Ministry of Agriculture, the product for the German market was cheaper.
- Tulip Luncheon Meat from Germany contained pork, while the Czech version contained mechanically separated meat from poultry.

The Food Chamber of the Czech Republic has subsequently stated that according to its tests, two-thirds of the foods by the same brands bought in Germany are cheaper than in the Czechia, and are often better-quality products. According to the Chamber, the price difference has sometimes exceeded one-third of the value of the goods.

The Ministry of Agriculture of the Czech Republic [34] adds, however, that it is not possible to determine unequivocally that some of the countries sell significantly better food. The differing composition of products can be influenced by the taste preferences of consumers in a particular region, or the availability of local ingredients.

Five to ten percent of foods have slightly different ingredients due to so-called regional flavors. This means that the tastes are adapted for the locality. It is clear, for example, with bread as it tastes different in Ostrava and in Prague. Often the different ingredients are stated in the food data on the label, although the packaging of the products is otherwise the same.

Recent food fraud scandals have further increased the need to combat fraud across supply chains [35]. However, claims that there is less or more of particular ingredients in a product, for example, in chocolate, because of regional requirements are not true. Food experts tested two identical chocolate rabbits years ago. The rabbit sold in Czechia and the one in Germany were the same size, but the German one weighed more. They also found that there was a lot more cocoa in it.

However, as MEP Olga Sehnalová says, the taste and price preferences described by the manufacturers are not true. Thus, Czech and German consumers buy different goods for approximately the same price. The Ministry of Agriculture of the Czech Republic used the results of the research as an argument in negotiating food quality solutions at the European level.

4.4. Food Quality Research Carried Out by the European Commission

"The presence of differences in the composition of seemingly identical branded (food) products (DC-SIP) (the DC-SIP is also referred to as "dual food quality" in the literature) across different Member States (MS) has been a growing policy concern in the EU over the last few years" [36]. To the best of the authors' knowledge, there are only a few studies that use data containing multiple versions of the same branded food products offered across countries. For example, Lewis et al. [37] discovered heterogeneity in fast-food sugar content across three countries (USA, Germany, and Australia) and suggest that reductions are possible and should be implemented to reduce health risks associated with excess added sugar intake.

However, prior literature has predominantly focused on theoretical models that discuss incentives for firms to differentiate their products either within a country or across countries. According to this literature, firms' optimal product composition differentiation

depends on several drivers such as consumer demand [38–41], national regulations [42], or production factors [43]. Although some of these studies have empirical applications [38–40], none of these papers use such a disaggregated level of data that it can determine the type of branded products and variations of the same and similar branded products (i.e., variations of a branded product with the same/similar packaging) sold in different markets.

The food company Dr. Oetker, the Heineken brewing group, the baby food manufacturer Hipp, Philadelphia Cream Cheese, and the confection producers Milka and Ferrero all have one thing in common: according to a recent survey of the European Commission, they sell their products in the same packaging but in varying qualities in different member states. These products make up 9% of the tested samples, and another 22% had a different composition and a slightly similar label in different countries (a total of 31% of all tested products thus showed discrepancies referred to as dual food quality).

In some cases, there were discrepancies in product content measured as a percentage, and the European Commissioner for Justice, Consumers and Gender Equality, Věra Jourová, explained the different standards of different member states. At the same time, the study showed that this is not just a problem of Central and Eastern Europe, but of the entire European Union.

The Commission started its own food testing following a number of similar studies in the member states between 2016 and 2018. However, their results cannot be compared according to the EC due to the different approaches taken in each study. The Commission evaluated 1380 samples of 128 different food products from nineteen member states. All countries were invited to participate in the study, but 9 countries did not participate [3].

4.5. The Differing Quality and Safety of Fruits and Vegetables (and Bio-Products) in Supermarkets and Farmers' Shops in Czechia

The quality and safety of fruits and vegetables are of particular importance for humans, because they are sources of vitamins that cannot be obtained from other foods. However, often while making their shopping decisions just upon price, consumers do not hesitate to spend exorbitant amounts of money on vitamin supplements.

Czech apples are the most popular type of fruit and, at the same time, the main source of vitamins for Czech consumers. They are best consumed in September and October when being picked. If stored properly, they can last as long as the beginning of the following summer; then they are imported from Italy and Spain, or even South America, because domestic supplies run out.

Own Survey in Chain Stores

Our survey, carried out in two supermarkets of the multinational retail chain Kaufland (Schwarz, Germany) in Prague in August 2019, showed that the apples offered were placed in non-cooled boxes situated within reach of passing customers. That means in a place with a higher temperature due to the movement of customers. The apples were rather shiny at first sight, probably treated against quick drying by waxing. None of the varieties offered had the natural aroma of fresh fruit.

Fresh fruit is, naturally, much tastier than long-stored fruit. While summer and autumn varieties of apples, cooled to just above the freezing temperature, may be kept for several weeks only, cooled winter varieties may be stored for several months thanks to their longer ripening process [44].

- Fruits and vegetables offered in supermarkets go bad quickly due to high interior temperatures. Although retailers claim it is for greater customer comfort, the obvious reason is to save energy. Foods that are supposed to be placed in cooling boxes are often stored on corridors and in other available spaces.
- A different approach typical of specialized shops with farmers' products may be seen, for example, in "Kunratická stodola", offering premium fruits and vegetables. People shopping in farmers' shops can wear warm clothes all year round because the temperature inside the special cooling boxes used to store lettuces, mushrooms, and

herbs, which are accessible to customers, is only 4 °C. Such shops consume approx. CZK 2000 (USD 92.3) of energy per day, but offers fresh produce at all times.

- Wax (usually beeswax) and shellac (a resin secreted by female lac bugs) are used for improving the firmness and glossiness of apple skins. Shellac is also used for varnishing musical instruments, and until 1950 gramophone records were made from it. According to food preservation specialist Aleš Rajchl of the University of Chemistry and Technology Prague, fruit waxing is not a new method. The protective wax layer prevents water from evaporating and, thus, prolongs the shelf-life. Of course, it is also used for aesthetic effect. When applied in a very thin layer, the wax is not harmful; natural protective layers of wax substances can often be found on fruit.
- According to the findings of the Czech Union of Allotment and Leisure Gardeners, imported fruit usually contains far more chemical residues. In Czechia, an apple tree is treated by spraying three times a year at the most. In the spring, it is sprayed against overwintering pests, then subsequently against fungal diseases, and before the harvest against sooty blotch, a fungal disease causing black blotches on the skin. Fruit-growers also plant resistant varieties that do not need to be treated with many chemicals. The apples imported to Czechia are usually sprayed ten to fifteen times a year [45]. Allegedly, apples in US supermarkets were treated chemically in the past. Thanks to this "care" they looked perfect, almost artificial. However, they did not pass tests for pesticide residues and the treatment was abandoned. Apples in Czech supermarkets are only washed with water and slightly brushed. Some varieties, such as Gloster, have natural glossy skin, belonging to the so-called greasy varieties. In some varieties glossiness may be the sign of ripeness; in others, such as James Grieve, it is suspicious, indicating that the fruit is overripe and, thus, mealy [44].
- However, the various pesticides applied profusely not only to apple trees but also to citrus trees are much more serious threats for humans. Thus, oranges, lemons, and limes should be thoroughly washed before being consumed. Since even thoroughly washed citrus skin is not completely free of pesticide, only skin from chemically untreated fruit should be used for cooking.

Such fruit may be purchased in farmers' shops (e.g., imported from Spain), identifiable by its smooth skin or more pleasant odor (a much safer indicator), and also by its price, which is roughly double that of normal produce because this fruit goes bad quickly. However, it tastes much better.

Our survey carried out in a Kaufland supermarket showed that the majority of citruses (oranges and lemons) were chemically treated. However, customers were informed about this fact on visibly displayed signs.

The Kaufland retail chain also offers apples and citruses that were not chemically treated, mainly in the form of bio-products produced from these fruits, such as bio orange juice, bio apple juice, or vegetable juice. These fruit and vegetable juices were offered at promotional prices: orange and apple juices, with a 25% discount, at CZK 29.90 (USD 1.38) per liter of 100% fruit juice; bio-quality vegetable juice, with a 23% discount, at a final promotional price of CZK 22.90 (USD 1.05) per liter.

Both agricultural companies and retail chains thus have been accepting social and environmental responsibility. To choose bio-quality is always the right choice. Food products labeled as "bio" offered by retail chains are of controlled bio-quality. Since such food is grown without the use of genetic modifications, synthetic fertilizers, pesticides, and herbicides, it helps to maintain a better environment and better living conditions for animals.

4.6. The Authors' Own Research on Food Quality in CULS in 2020

The experimental part is based on data obtained by a questionnaire survey, which was aimed at university students from agricultural universities with a professional interest in food quality due to their higher level of theoretical knowledge in this area than that of the general population. The questionnaire survey had 242 respondents in the age category of

20–30 years, with women as the majority (71.07%). Women are more interested in personal and general health, healthy lifestyles, and food composition, and they were more willing to answer the presented questions. Nevertheless, it cannot be said without verification that the gender perspective on the issue of food quality is the same. Consumers in Central and Eastern European countries that joined the EU after 2004 have often pointed to the quality discrepancy of identical foods and other products. Based on their own experience, they believed that the quality of some products of the same brand is lower in their country than in the original EU member states. The questionnaire asked young people about their awareness of the ongoing serious debate at the European level on whether the quality of the food is the same in different countries, and they were also asked about whether they believe in the quality discrepancy of the food sold in different EU countries. Respondents that were informed about the issue made up 74.38%, and 71.90% of the respondents were convinced about the dual quality of food. Respondents with no practical experience of varying food quality made up 22.31%. Table 1 shows women's and men's responses to the questions presented in the questionnaire.

Table 1. Gender perspective from the results of the questionnaire survey for α (number of respondents: 242).

Question Number	Test Criterion χ^2	*p*-Value	Cramér's V	C
2. Knowledge of European debates on dual food quality	3.7139	0.0540	−0.1239	0.1229
3. Belief in the truthfulness of dual quality	6.8752	0.0321	0.1686	0.1662
4. Active interest in information on the composition of food products	0.1676	0.9196	0.1686	0.1662
5. Active interest in food additives	4.6563	0.0309	0.1387	0.1374
6. Active interest in the origin of food products	5.8753	0.0154	0.1558	0.1540
7. Tracing of food origin data	1.5037	0.4715	0.0935	0.0931
8. Practical experience with dual quality of the same product	0.1731	0.9171	0.0267	0.0267
9. Knowledge of the existence of an EU directive on identical products of a varying quality	4.2721	0.0387	−0.1329	0.1317
10. Price or quality preferences when buying food	0.0657	0.7977	−0.0165	0.0165

Question 3 shows statistically significant differences between the genders (Table 1). Women are far more attuned to their surroundings. If an argument is convincing to them, then they believe the argument or have a neutral attitude. Men require more objective evidence for their beliefs. Figure 6 shows the relative distribution of answers to the question of the public's belief in the dual quality of food products sold in the EU by gender.

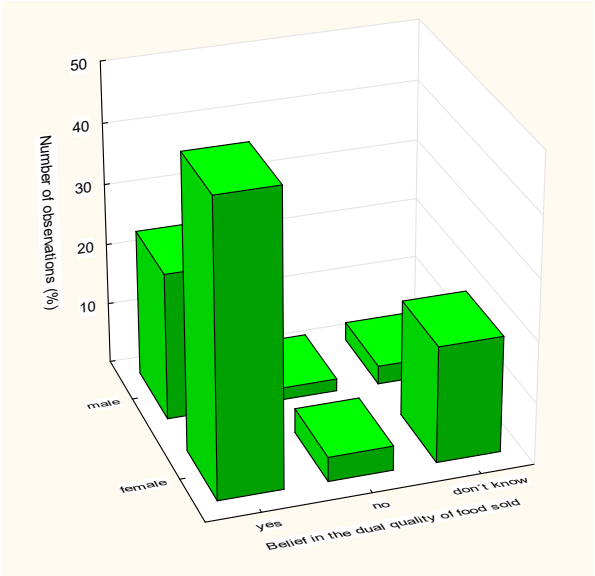

Figure 6. Belief in the truthfulness of dual food quality.

Colorants and preservatives (question 5) are important additives to maintain the quality and shelf life of food on its path from producer to consumer. If this path is short in time, then the use of additives is limited. This is the case with regional food products, which are offered to consumers fresh with a clear and verifiable composition, including the possibility of personal contact with the producer. Additives used in controlled technological processes of food production are not harmful from a health standpoint. Their overuse associated with the individual health condition of the consumer can lead to health complications. From Table 1, it is clear that there is a statistically significant difference between women and men when looking at the qualitative composition of food products. Women are more interested in the composition of food products and, in particular, in additives that can have a negative impact on their health and especially on the health of members of their household.

Women have a similar interest in the country of origin of their food. A statistically significant correlation between men's and women's interest in information about the geographical origin of food products (question 6, Figure 7), but no statistically significant difference was found between the genders in the regular tracing of the origin of food products (question 7). This time the respondents consisted only of those with any interest at all in the geographical origin of food products. They made up 71.07% of the total number of 242 respondents.

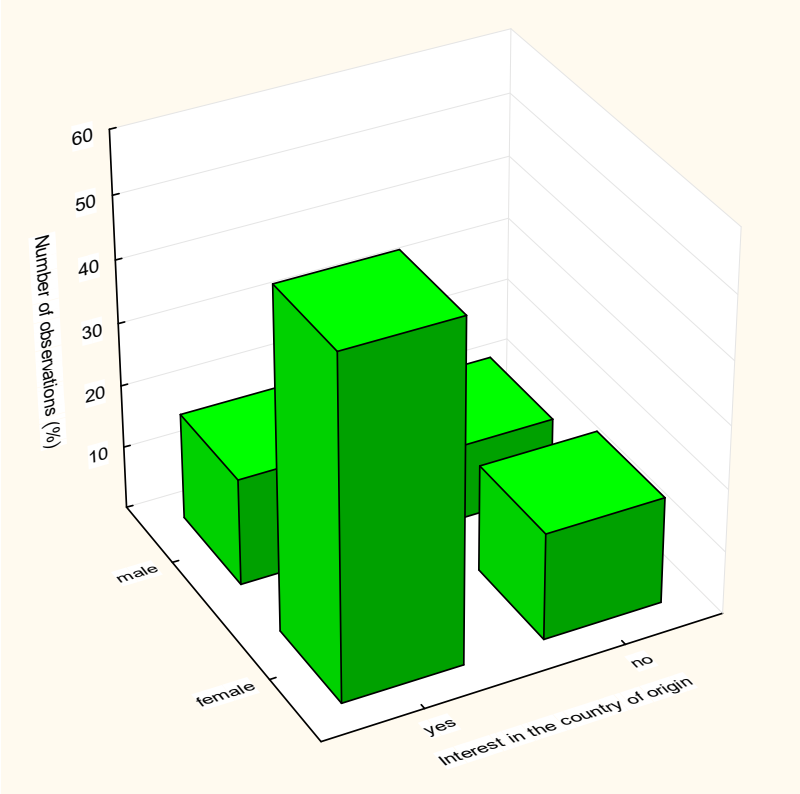

Figure 7. Interest in the country of origin of food products by gender.

Given that the survey was conducted among students assumed to have a certain professional relationship with the problem and greater technical knowledge, they were asked about their knowledge of European legislation dealing with identically branded food products of varying quality. From Table 1, it is clear that there is a significant difference between women and men in their knowledge of the European legislative framework for banning the identical branding of food products of varying quality on the European market. Figure 8 shows the distribution of answers in a sample of 242 respondents.

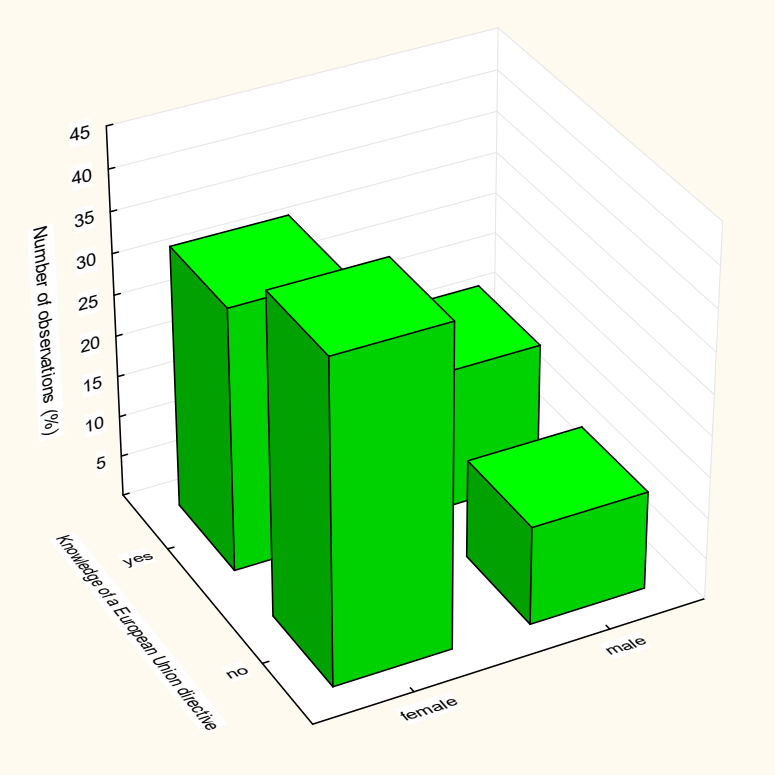

Figure 8. Knowledge of the EU directive on identically branded food products of varying quality on the European market.

Despite the above statistical results, it can be stated that all the identified correlations were of a very weak nature. The population of educated men and women in the Czech Republic has relatively homogeneous views on food product quality.

As shown by a comparison of previous research and our own research in the period between 2019 and 2021, there has been a significant positive shift in views on the need for food products to be of the same quality in all EU countries, both among the professional public, governments, and the population. The change in food quality laws is particularly positive. The tightening of state control, as well as the efforts of retail chains and farmers to gain a good reputation with consumers, contributed to the increase in food safety.

5. Discussion

The research was carried out by collecting information on quality controls and food safety checks performed by state institutions, as well as by observing and analyzing knowledge on the way that food is sold in retail chains. The research and the subsequent analysis of the findings have confirmed the validity of the previously formulated hypothesis. Exceptions to the rule in the hypothesis consist only of the following:

- Attempts by some foreign producers to export to Czechia unacceptably chemically treated products (see Section 4.5);
- Deliveries of food (especially fruit) that has not been sold abroad in time and is starting to rot.

In Czechia, food is regularly checked by designated organizations, and producers take this into consideration when producing it. The fruit grown in Czechia certainly does not contain residues of the toxic substances that protect imported products (e.g., citrus fruits), especially against molds.

However, as demonstrated by the recent case of imports of eggs from Belgium and the Netherlands, which contained the insecticide Fipronil, it is not possible to completely prevent exceptional cases of imports of harmful foodstuffs [46]. "In the usual, current

approaches to food management, honesty is presumed. This presumption makes us generally vulnerable to deception" [47], but we also have to consider that food fraudsters will put all their efforts into disguising their illegal activities. "Therefore, in order to tackle food fraud, we need to shift from the safety-based approach to fraud prevention and vulnerability reduction approach and take into account these deliberate and disguising aspects" [48].

The greater problem is the import of fruits and other foods that are not sold in time in Western European countries to stores in Czechia and other East European countries. In the case of inappropriate storage, rapid rotting and toxic mound contamination affect most of the fruit placed near them (especially raspberries and blackberries).

However, according to experts and our research, it is not possible to judge objectively whether the food being sold is better or safer in one country. It cannot be claimed in general, but, in some cases, manufacturers favor the German and Austrian markets. Specific examples will have the largest effect on eradicating dual food quality. For example, the Globus and Kaufland chains have newly committed themselves to banning varying food quality in their stores in different countries.

Food producers often argue that people's taste preferences vary across countries. This may, of course, simply be an abstract concept and an excuse. "However, if a producer such as Coca-Cola can prove that it has carried out extensive testing of the taste preferences of consumers, it may continue to have varying product compositions in different countries", says EU Commissioner Věra Jourová, who is in charge of consumer protection [49].

There are two main reasons why food products that could be produced in the Czech Republic are imported from abroad:

- The Czech Republic has a low level of self-sufficiency in the production of certain food products due to the higher production costs for Czech farmers (and thus a higher market price) as compared to farmers abroad.
- Three-fourths of all food purchases by Czech consumers are made in stores of multinational retail chains. Due to their returns to scale, multinational retail chains offer food at more favorable (often discounted) prices. Czech consumers are particularly happy to buy at discount prices (discounted products make up half of all food sales).
- These retail chains are undoubtedly interested in delivering goods to stores in the Czech Republic at lower prices that cannot be sold in time in their home country at a higher price (and which would have to be disposed of after the expiration date). In particular, in the case of fruit and animal products, this has an impact on the shelf life of the food sold and, in combination with inappropriate storage methods, this leads to the early spoilage of products.

But why do so many Czech consumers buy food in large retail chains? The essence of the problem lies in the lower purchasing power of the population. It is best expressed by the average wage indicator, which has a lower value compared to developed western countries.

Quality food at higher prices, for example in specialized stores such as Kunratická stodola, is currently purchased mainly by population groups with higher incomes.

The decision of the EC to ban "identically branded dual quality food products" in different EU countries and strict control by local food organizations will undoubtedly help eliminate this problem. Inspections by the Czech Agriculture and Food Inspection Authority (CAFIA) and better public awareness of these unfair practices will contribute to eliminating the sale of poor-quality or spoiled food.

To achieve this goal, the recommendations outlined in the following sections could be implemented.

5.1. Resulting Recommendations for the State

- The CAFIA should be responsible for thorough quality inspections of food offered in retail chains in order to prevent the sale of improperly stored food products, food products contaminated with mold, and products with similar defects (including expired goods).

- The CAFIA should also ensure that products, particularly those produced by multinational food producers, are of the same quality so that products with the same packaging have the same properties and composition in the Czech Republic as in other European countries. The varying compositions of these products could also not be justified by different consumer preferences or the availability of raw materials in a given country.
- Provide grant support to media outlets dealing with the professional condition of food products sold. The economic position of these scientific publications is not profitable due to the low number of copies and often these sources of important information disappear.

5.2. Resulting Recommendations for Consumers

- Products that are improperly stored or already obviously contaminated with mold (and are therefore unhealthy) should not be purchased, even if they are offered at affordable prices.
- Despite the fact that they are more expensive, precedence should be given to Czech products that are sold at farmers' markets or in the stores of local producers, where the freshness, typical aroma, and desired appearance are evident—a smaller amount of high-quality food is of greater benefit to the human body than a large amount of low-quality food.

5.3. Resulting Recommendations for Producers

The composition of the products declared on the packaging should be strictly adhered to, as the public perception of the poor quality of these food products in the media can lead to a significant decline in demand for other food products offered by these producers.

5.4. Resulting Recommendations for Multinational Retail Chains

- Change the way fruit and vegetables are stored so that food is not damaged during handling or as a result of temperature changes and check their condition on shelves more frequently (e.g., whether they are contaminated with mold or partially spoiled).
- Retail chains should exclude dual quality and defective products from sale, return them to manufacturers, and not enter into new contracts with these suppliers.
- Pay better wages to employees who deal with the storage, transport, and distribution of food on shelves, so the quality of these products is not unnecessarily reduced.
- Conversely, thoroughly penalize employees for detected violations (as opposed to proper food handling) after delivery and storage.

5.5. Implications for Theory

- It would undoubtedly be interesting to monitor changes in the quality and range of food products offered in stores in the Czech Republic after the introduction and enforcement of the amendment to the Food Act and to compare it with the current situation.
- As the standard of living of the population increases, changes (based on the mentioned economic model) in consumer preferences should be monitored and further research focused accordingly.

5.6. Limitations of the Research

The research focused mainly on consumer behavior in the Czech Republic and its food quality in comparison with Germany, the Czech Republic's largest trading partner.

Based on our model (see Section 3.2), the phenomenon in question may be explained as follows: For Czech consumers with a higher parameter e, food consumption forms a bigger share of their total consumption, and they do not have as many options to replace them with substitution goods as German consumers do. For German consumers, food consumption forms a smaller share of their total consumer expenditures, and they have

more options to use substitution goods. Thus, the price elasticity of demand is higher for German consumers, corresponding to consumers with a lower parameter e.

6. Conclusions

Both agricultural companies and retail chains are now accepting social and environmental responsibility. The quality and safety of fruits and vegetables are of particular importance for humans, because they are sources of vitamins that cannot be obtained from other foods. Twenty-four selected food products sold under the same name by the multinational retail chain Albert in Germany and Czechia were tested by the University of Chemistry and Technology, Prague. One-third of them varied in their composition, although all of them were presented in the same way, so that the consumer would expect to find identical content. As the comparison indicates, unless multinational producers change their current behavior, consumers will prefer purchasing products from Czech producers, including those offered at farmers' markets, and shopping in neighboring countries where higher-quality original products may be found.

The Ministry of Agriculture of the Czech Republic has been running a campaign in support of domestic food for a long time, and it has been a sharp critic of retail chains for allegedly giving precedence to foreign products. This is now beginning to show in the behavior of both customers and retail chains. It has undoubtedly exerted more consistent pressure on retail chains, which are beginning to monitor the origin of goods they order and replace them with Czech products to a greater extent. People also put far more thought into what they buy and who made it, and they monitor the inspection results of supervisory authorities, which also affect their purchasing habits.

The number of Czechs who give precedence to quality when buying food is growing. Their share has increased from 35 to 40 percent in the last five years. Retail chains are responding to this trend by expanding their inventory to include organic products and products from local suppliers.

The adopted amendment to the Act on Food and Tobacco Products stipulates that products of a different quality marketed in the Czech Republic must also have different packaging, and this difference must be obvious at first glance. The responsibility for verifying compliance with the law is assigned to the Czech Agriculture and Food Inspection Authority, which can impose a very high fine (up to 50 million crowns for violating the ban on the sale of dual quality food products). The content of the amendment is explained using the example of canned meat. "The meat content and main ingredient must be the same. If a branded product normally contains pork, then the same product should not contain poultry, beef, or any other kind of meat when sold in the Czech Republic. It must be apparent at first glance," stressed the Minister of Agriculture of the Czech Republic M. Toman [50] regarding the amendment to the Food Act. After the amendment enters into force, it will not be possible to justify varying product compositions with consumer preferences or the availability of raw materials in the Czech Republic. The situation where Czech customers are buying goods of a different, inferior quality than a product with the same packaging in Western countries must be stopped.

The European Commission (EC) [51] has complied with the countries of the central and eastern parts of the EU, which have long sought to ban dual food quality. The Unfair Commercial Practices Directive, under the EC, now clearly stipulates that it is illegal to market identically packaged products with significantly different compositions in different EU countries. The change is part of broader regulations on EU consumer rules proposed by the Commission and currently being negotiated by EU member states and the European Parliament [51].

New research and, in particular, research publications, have thus significantly contributed to improving the quality and safety of food, especially in the new EU member states. In addition, the results of the research conducted by the authors of the article at CULS demonstrated a growing interest in the issue among young people working in the field of food production, and the active role of women in this process of change. It is

not only important that all measures adopted by the European Commission for ensuring identical food quality are integrated into the legislation of individual countries, but also to ensure that high-quality and safe food is subsequently available to all strata of the population in EU countries.

Author Contributions: Conceptualization, L.S. and R.S.; methodology, M.P. and A.S.; software, R.S.; validation, K.Š. and L.K.; formal analysis, A.S. and R.S.; investigation, L.S. and M.D.; resources, M.P. and L.K.; data curation, L.S. and R.S.; writing—original draft preparation, K.Š. and R.S.; writing—review and editing, M.P. and M.D.; visualization, M.D. and A.S.; supervision, L.S.; project administration, L.K.; funding acquisition, K.Š. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the Faculty of Economics and Management, Czech University of Life Sciences in Prague, grant number 20151024.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

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