European
Commission

JRC TECHNICAL REPORT

Economic determinants of differences in the composition of seemingly identical branded food products in the EU

An econometric analysis

Nes, K., Ciaian, P., Di Marcantonio, F.

2020

Joint Research Centre

EUR 30023 EN

Contact information
Name: Kjersti Nes
Address: Edificio Expo. c/ Inca Garcilaso, 3. E-41092 Seville (Spain)
E-mail: Kjersti.nes@ec.europa.eu
Tel. +34 954488356

EU Science Hub
https://ec.europa.eu/jrc

JRC119221

EUR 30023 EN

PDF ISBN 978-92-76-14245-4 ISSN 1831-9424 doi:10.2760/184019

Luxembourg: Publications Office of the European Union, 2020

How to cite this report: Kjersti Nes, Pavel Ciaian, Federica Di Marcantonio, Economic determinants of differences in the composition of seemingly identical branded food products in the EU: An econometric analysis, EUR 30023 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-14245-4, doi:10.2760/184019, JRC119221

Contents

Acknowledgements

We would like to thank all of the participants for commenting on, discussing, and sharing insight into the topic at the stakeholder meetings held in Seville on 14 May 2019 and in Brussels on 14 February 2020, where the outline of the analyses in this report was presented. We are grateful to Franz Ulberth for providing data collected though the EU wide comparison of quality-related characteristics of food products, and for his valuable input and support at various stages of the study. We would like to thank Jaroslaw Swierczyna from DG GROW for his close collaboration in delivering the workshop, and for his valuable comments and further input into this report. We thank Stefano Soro, Head of the Food Industry Unit (GROW D3) and Giampiero Genovese, Head of the Economics of Agriculture Unit (JRC D4), for their continuing support and additional input into the production of this report.

Authors

Kjersti Nes

Pavel Ciaian

Frederica Di Marcantonio

Executive summary

Over the last few years, practices relating to differences in the composition of seemingly identical branded food products (DC-SIP) observed across different Member States (MS) have been under intense scrutiny from policymakers and stakeholders in the European Union. Communications by the European Parliament (European Parliament, 2013; European Parliament, 2017; European Parliament, 2018) and the European Council (Council of the European Union, 2016) have stressed the importance of tackling the issue of DC-SIP, and requested the European Commission to investigate these practices and to find a solution at European level.

The objective of this report is to provide potential explanations for the occurrence of DC-SIP across MS. More specifically, the report utilises data from the EU wide campaign testing differences in the components of various products (European Commission, 2019b), in combination with economic data collected from various statistical sources (e.g. Eurostat, Eurobarometer, World Bank, Global Dietary Database), to examine economic drivers of DC-SIP in the European Union. The final dataset covers 19 different MS and 127 products. Econometric estimation – Probit estimator – is performed on this combined dataset to quantitatively identify economic drivers of DC-SIP. Potential economic drivers of DC-SIP are identified from economic literature, and factors related to consumer demand (Colen, Chryssochoidis, Ciaian, & Di Marcantonio, 2020), production, and specific MS (Russo, Menapace, & Sansone, 2020) are included. The following factors are considered in relation to consumer demand: differences in GDP per capita, dietary index, attitude index, and price level between countries. The following factors are considered in relation to production: shared official language, shared border, distance, company size, product complexity (product with three ingredients or fewer).

The key results of the report are as follows:

- Difference in GDP per capita is included to account for potential differences in willingness to pay for the product across countries. The difference in income levels between two countries has a statistically significant positive effect on the probability of occurrence of DC-SIP products. If two countries have identical income levels, the predicted probability of the product versions offered in these two countries being different is 39%. As income level difference increases, the probability of occurrence of DC-SIP between a given country pair increases. For the country pair with the greatest income difference, Denmark/Bulgaria, the predicted probability of a product being different is 52%.

- Two variables are included to control for cross-country differences in consumer preferences: dietary index and attitude index. The attitude index is statistically insignificant in all model specifications. Differences in current diet are, on the other hand, positive and statistically significant. This implies that a greater difference in diet between countries increases the probability that firms offer different product versions.

- Although the difference in price level among two MS has a positive effect on occurrence of DC-SIP, the magnitude of this effect is relatively small. This implies that the probability of the presence of DC-SIP between country pairs increases the greater the difference in price level between the countries, but that this effect is minor.

- As the distance between two MS increases, the probability that the versions are identical decreases. This relationship is expected, as products sold in MS farther apart are less likely to come from the same production plant.

- If a product is produced by a company with a turnover greater than 22 billion euros, the probability of a product being different between the country pair increases by around 8%. Similarly, less complex products – products with three ingredients or fewer – are about 25% less likely to be different for a given country pair.

- A greater difference in front-of-pack entails a greater probability of the presence of DC-SIP. Compared with identical front-of-pack, a product with similar packaging is around 22% more likely to be offered in different versions, while products with different packaging are around 37% more likely to have different versions between country pairs.

1 Introduction

Over the last few years, practices relating to differences in the composition of seemingly identical branded food products (DC-SIP) observed across different Member States (MS) have been under intense scrutiny from policymakers and stakeholders in the European Union. The issue of DC-SIP was brought to the attention of policymakers in particular by tests conducted in several MS which showed that some brand owners sell products across the single market with different composition, despite having the same or similar packaging (Borzan, 2017; CEU, 2017; Croatian Food Agency, 2017; European Commission, 2019b; European Parliament, 2017; Jancarikova, 2017; MPSR, 2017; Néhib, 2017; SZPI, 2015). Communications by the European Parliament (European Parliament, 2013; European Parliament, 2017; European Parliament, 2018) and the European Council (Council of the European Union, 2016) have stressed the importance of tackling the issue of DC-SIP, and requested the European Commission to investigate these practices and to find a solution at European level. Similarly, in his State of the Union speech in 2017, Commission President Jean-Claude Juncker explicitly referred to the issue of companies selling seemingly identical products with a different composition in different EU Member States, and stressed the need to take action to address DC-SIP practices (European Commission, 2017).

As a result of these developments, the Joint Research Centre (JRC) of the European Commission, in collaboration with experts from MS competent authorities and stakeholders in the food chain, developed a harmonised methodology to improve comparative testing for DC-SIP in food products across MS (European Commission 2018). This methodology was then applied to provide further evidence on whether the composition of various branded food products differs among MS. The results of this EU wide testing campaign were published in June 2019. Overall, 19 MS participated and 128 branded food products were included in this campaign. Food products evaluated were found to have differences in composition despite their front-of-pack appearance being identical (in 9% of cases) or similar (22% of cases) (European Commission, 2019b).

The objective of this report is to provide potential explanations for the occurrence of DC-SIP across MS. More specifically, the report utilises data from the EU wide testing campaign (European Commission, 2019b), in combination with economic data collected from various statistical sources (e.g. Eurostat, Eurobarometer, World Bank, Global Dietary Database), to examine economic drivers of DC-SIP in the European Union. Econometric estimation – Probit estimator – is performed on these combined datasets to quantitatively identify DC-SIP drivers.

Although the debate about DC-SIP often focuses on potential quality differences between different versions of same or similarly branded food products across MS, this issue is not covered in this report. This report contributes to the debate by providing a broader approach to differences in branded products than their quality attributes. In particular, the report attempts to investigate to what extent economic drivers explain the presence of DC-SIP between MS, without taking into consideration the intensity, magnitude or quality of compositional differences of seemingly identical branded food products.[1]

The rest of the report is organised as follows. Section 2 provides background to DC-SIP and an overview of products included in the study. Section 3 describes the methodology applied and data used for the analysis. Section 4 provides the estimated results. Section 5 concludes the report.

[1] This approach is taken because the data available do not allow such analyses. In order to quantify drivers of the intensity, magnitude or quality of compositional differences between MS in seemingly identical branded food products, a significantly larger dataset would need to be available for each branded product. It would not be straightforward to perform these analyses across different types of branded products because products are not comparable (e.g. the same intensity or magnitude of compositional differences between two different products may have different implications for quality).

2 Background and data selection

2.1 DC-SIP data

The European Commission defines DC-SIP as 'the case of marketing a good, in one Member State, as being identical to a good marketed in other Member States, while that good has significantly different composition or characteristics (European Commission, 2019a)'. Although tests on DC-SIP were carried out by various Member States prior to 2018, the tests were based on different methodology and thus it is difficult to compare between them (Borzan, 2017; CEU, 2017; Croatian Food Agency, 2017; European Commission, 2019b; European Parliament, 2017; Jancarikova, 2017; MPSR, 2017; Néhib, 2017; SZPI, 2015). As a result, the JRC developed and applied a harmonised testing methodology to compare branded food products across MS (European Commission, 2018b; European Commission, 2019b). Given that the dataset collected based on this methodology – the EU wide testing campaign (European Commission, 2019b) – provides comparable information across MS, it is the primary data source used in this report to account for the occurrence of DC-SIP among MS.

The EU wide testing campaign initially considered a list of 145 products from 50 brands (European Commission, 2019b). The criteria and procedure for product selection in this EU wide testing campaign were as follows: 'All EU Member States were invited to suggest products for inclusion in the EU wide testing campaign. Nominations of products for testing were received from Bulgaria, Czech Republic, Germany, Hungary, Lithuania, Poland, Slovenia and Slovakia. A significant part of the products were included in the study because consumer protection authorities or consumer associations had received complaints about certain products on their domestic markets that differed from products offered in foreign, mostly neighbouring, Member States. This set of products was complemented by products of a similar nature, which had not been the subject of previous studies, with the intention to increase the representativeness of the market basket' (European Commission, 2019b).

Table 1. Number of products considered in the analyses by product category

Number of products	Product category	Type of products
20	Confectionery	Dessert, sweet biscuit, sweets, chocolate, Nutella
14	Coffee and tea	Coffee and tea
14	Condiments	Mayonnaise, olive oil, ketchup, soy sauce, sweet and sour sauce, spices
13	Dairy	Cheese, ice cream, yoghurt
13	Processed food	Processed seafood, meat, fruit and vegetables
11	Soft drinks	Juices, iced tea, soda
8	Savoury snacks	Chips, tortilla chips
8	Baby food	Various baby foods
7	Cereals	Various cereals
7	Alcoholic beverages	Beer and whiskey
6	Soup	Stock cubes
6	Ready meals	Pizza and spaghetti

Source: Authors' own classification of the products included in European Commission (2019b).

Data collection took place between 6 November 2018 and 7 January 2019. All EU MS were invited to submit information, but only 19 Member States participated in the EU wide testing campaign.[2] Out of the 145 products selected for the testing campaign, information was collected by the 19 MS on 128 products.[3] Not all MS submitted data for all 128 products; hence the number of observations varies between products depending on the availability of a given product across the 19 MS. Overall, the database contains 1,380 individual observations (products and MS) (European Commission, 2019b).

2.2 Products included in the study and product availability

Table 1 shows the number of products available within each product category, for the 127 products that are included in the report on the EU wide testing campaign.[4]

As not every product is available in all countries, Table 2 shows the distribution of how many products are available in each country and the average number of versions available per product. For example, the first row in Table 2 can be read as follows: 11 products are available in 3-5 MS, with an average of 2.11 versions existing per product. Note that more than half of the products are available in at least 10 of the 19 countries. In accordance with European Commission (2019b), out of the 127 products included in the sample, 42 (33%) are considered to have identical composition, while the rest (67%) appear in similar or different versions. On average, 3.46 versions exist per product. At most, 12 different versions of the same branded product are placed on the market in MS included in this study.

Differences in front-of-pack appearance among the versions of a product are also considered. European Commission (2019b) divides the front-of-pack of the products into three different categories: identical, similar and different. If there are only small variations in characteristics of the packaging, the front-of-pack is considered similar; if the versions of the product have different appearances, the front-of-pack is considered different.[5]

Figure 1 shows the distribution of the differences in product composition and front-of-pack appearance. According to Figure 1, 9% of the food products evaluated were found to have differences in composition despite identical front-of-pack, and 22% despite similar front-of-pack. The rest of the products evaluated were either identical (33%), had similar compositional characteristics (9%), or had a different composition and also a different front-of-pack (27%) (European Commission, 2019b).

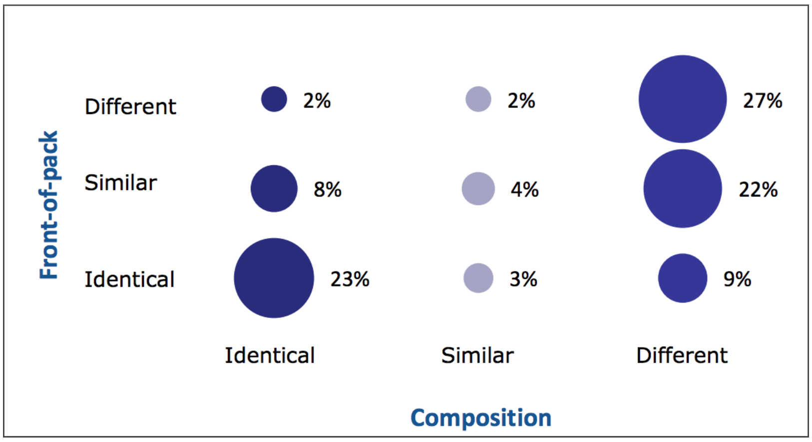
Table 2. Product availability and average number of versions

Number of products available	Number of MS	Average number of versions per product
11	3-5	2.11
44	6-10	2.72
39	11-15	4.75
30	16-19	3.40

Source: Authors' own calculations based on European Commission (2019b).

[2] These MS include Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, France, Germany, Greece, Hungary, Italy, Latvia, Lithuania, Malta, Poland, Slovakia, Slovenia, Spain, and the Netherlands.
[3] The harmonised methodology requires that information from at least three MS are collected for each product; 17 products were excluded from the dataset for not fulfilling this requirement (European Commission, 2019b).
[4] One product (pineapple slices) was dropped from the samples because the versions available in different MS were considered to be different products.
[5] A more detailed description of the methodology can be found in European Commission (2019b).

Figure 1. Classification of product composition and front-of-pack appearance



Source: Figure 4 in European Commission (2019b).

2.3 Companies' rationale for providing different versions of the same branded product

As part of the EU wide testing campaign, companies whose products are included in the campaign were invited to submit a response to the test results. Out of the 128 products included in the study, responses were submitted for 87 of the products (European Commission, 2019b). Figure 2 shows the rationale given by the companies on why their product composition differs. Note that for some products, the companies provided more than one rationale.

Heterogenous consumer preferences and national regulations are the most frequent reasons given why the companies offer different versions of the same product in different MS. Adapting products to local consumer preferences is given as the reason why products differ for 32 products (37% of those for which rationale was provided); for instance, Becel/Flora argues that 'some consumers prefer a more savoury taste, some consumers prefer a creamy taste'.

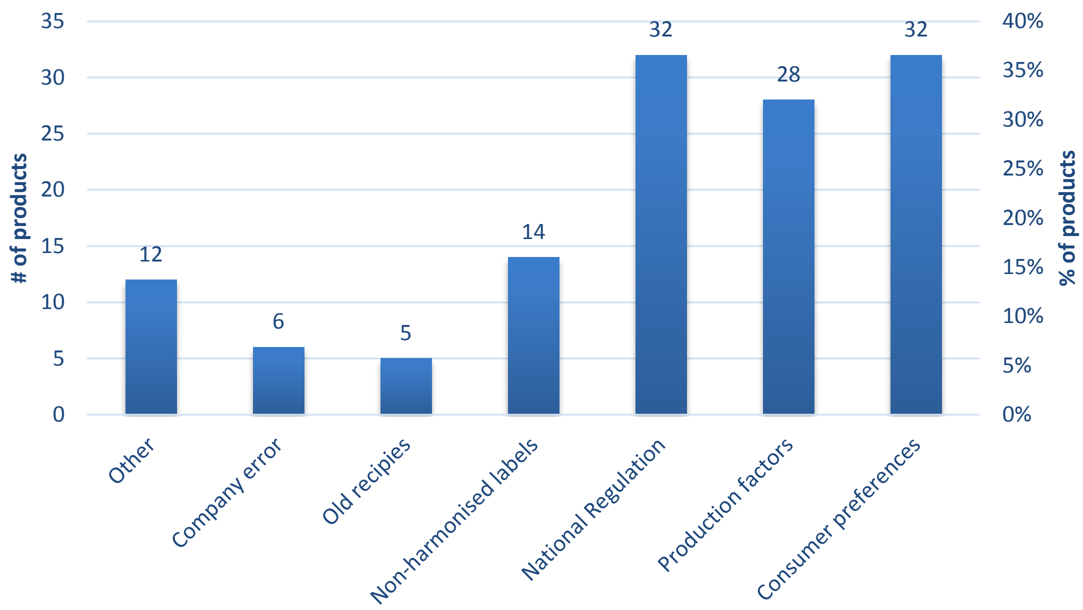
The companies argue that, for 32 products (37% of products for which rationale was provided), disparities in the ingredients are due to non-harmonised regulations among MS. For instance, Iglo argues that variations in fish content in their fish fingers are due to a minimum limit of 65% fish content in fish fingers in Germany, imposed by the Fischleitsatze.

Production factors are given as a rationale for introducing local versions for 28 (32%) of the products. These include difficulties with perfect harmonisation of recipes, variations in production techniques across different plants, use of local ingredients, and variations among local suppliers. For 14 (16%) of the products, the companies argue that some of the differences in composition are due to non-harmonised labels; for instance, differences in nutrient content are due to rounding issues on the labels, or countries having different norms on how to label ingredients.

For five (6%) of the products, the companies claim that they have modified the product recipe and that differences in ingredients within a product are due to products with an older recipe still circulating in some countries. Also, in a few cases, the companies argue that the products tested were in fact not the same product. Other reasons for providing different versions of a product across MS are given for 12 (14%) of products.[6]

[6] Other reasons include one baby food having age-adjusted recipes to be marketed to different age groups (Hipp Combiotic 3), or the company having a slightly different recipe based on the size of the chocolate bar (Milka Whole Hazelnuts). This category also includes cases where, although the companies responded to the survey, they did not specify the rationale behind differences in the composition of a product.

Figure 2. Companies' rationale for providing different versions of a product (% of products for which rationale was provided; number of products)



Source: Authors' own classifications of responses provided by companies in the Annex to European Commission (2019b).

3 Methodology and data

The main objective of the report is quantitative estimation of economic drivers explaining the occurrence of DC-SIP across products and MS covered in the European Commission (2019b) study. In principle, estimations can be conducted either for each product separately, or across all products pooled together. Estimation at product level allows us to take into consideration the magnitude of differences in the composition of seemingly identical branded products. In the cross-product estimations, only drivers of DC-SIP can be considered; the magnitude of differences in product composition cannot be considered because products are not comparable (i.e. composition differs between branded products, and the same ingredient has different quality implications across products).

Given that 19 MS participated in the testing campaign, there is a maximum of 19 versions possible per product,[7] which implies too small a sample size to obtain statistically robust estimations at product level. Consequently, cross-product estimation is applied in this report. That is, products are pooled together and each observation corresponds to a combination of country pair (e.g. Denmark/Bulgaria) and product (e.g. Nutella). Using data from European Commission (2019b), we determine whether DC-SIP is present for each country pair and product. This information is then used to construct the dependent variable used in the econometric estimation. That is, the dependent variable, D_{ijk}, is a binary variable that takes the value 1 if the composition of the product is different in a given country pair, and 0 otherwise. This leads to estimation of an equation that identifies drivers behind the probability of the product having different composition (i.e. DC-SIP being present) between two countries:

$$\text{(1)} \qquad \boldsymbol{P\big(D_{ijk} = 1 \big| X\big) = \Phi\big[\alpha + \beta\Delta CD_{ij} + \gamma \mathrm{PF}_k + \delta CF_i + \delta CF_j + \varepsilon_{ijk}\big]}$$

where *i* and *j* represent country pairs *i* and *j*, and *k* represents the product. The dependent variables $CD_{ij}, \mathrm{PF}_k, CF_i$ and CF_j are explanatory variables (drivers of DC-SIP) and ε_{ijk} is an error term. A similar approach was used, for example, to study consumer dietary choices and demand for product characteristics (Gracia & De Magistris, 2008; Cranfield, Henson, & Blandon, 2012; Zepeda & Li, 2007).

The objective of equation (1) is to estimate drivers explaining the likelihood that DC-SIP is present across country pairs. The selection of the explanatory variables (drivers) in the estimated equation (1) is based on the conceptual and empirical literature. Literature suggests that the key drivers of the economic determinants for the content of branded food products are consumer demand factors (Colen, Chryssochoidis, Ciaian, & Di Marcantonio, 2020; Di Comite, Thisse, & Vandenbussche, 2014; Saitone & Sexton, 2010; Valli & Traill, 2005); production factors (Russo, Menapace, & Sansone, 2020; Schmid & Kotulla, 2011; Brambilla, 2009); and country-specific factors (e.g. the nature of competition in the food chain within the country, national regulations, or access to technology) (Russo, Menapace, & Sansone, 2020; Inderst & Shaffer, 2007). For this reason, as specified in equation (1), the probability that the composition of a product is different in a country pair is a function (Φ) of variables related to differences in consumer demand factors between country *i* and *j* (ΔCD_{ij}), production factors (PF_k), and country-specific factors (CF_j and CF_i).

Two common estimation techniques are usually applied to estimate binary dependent variables: a linear probability model (LPM) and a Probit model. As the LPM gives no guarantee that the estimated probabilities fall between 0 and 1, the Probit estimator is used to estimate equation (1). The Probit estimator assumes that the function Φ in equation (1) follows the normal distribution, and thus the estimated probabilities are in the range [0,1] (Cameron & Trivedi, 2005).

3.1 Consumer demand factors

ΔCD_{ij} is a vector containing variables related to differences in demand factors between country *i* and *j*. Several variables were added in equation (1) to proxy for demand factors related to consumer willingness to pay (WTP) (vertical preferences) and cross-country consumer food preferences (horizontal preferences), for food attributes which might potentially impact the occurrence of DC-SIP between MS.

An important determinant of consumer food choices, and in particular consumer preferences over different product attributes (vertical preferences), which ultimately affects firms' behaviour with respect to DC-SIP, is consumer WTP for product quality (Colen, Chryssochoidis, Ciaian, & Di Marcantonio, 2020; Russo, Menapace, & Sansone, 2020; Saitone & Sexton, 2010). The cross-country differences in WTP are proxied by the difference

[7] However, as discussed in the previous section, the number of versions per product varies, with a maximum of 12 versions found.

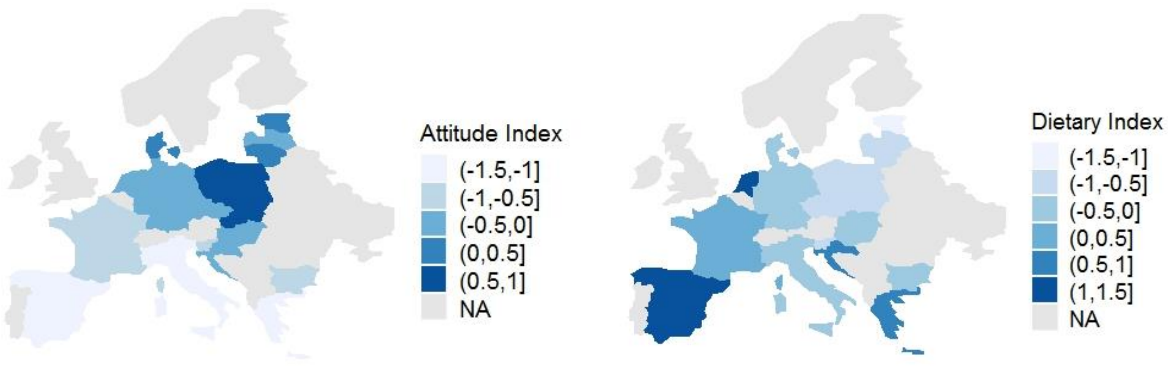
in GDP per capita between MS studied – Δ*GDP per capita* – extracted from Eurostat. Likewise, to reflect the importance of prices in affecting consumer food choices, a variable that accounts for differences in price level between MS – Δ*Price level* – is included as an explanatory variable. The price level variable is constructed based on the price level indices (PLIs) obtained from Eurostat for the year 2017. The PLIs provide a comparison of MS price levels relative to the EU average. The data contain PLIs for various food products, and the PLI for a given product is assigned to the corresponding product in the dataset used in the estimations. For instance, for the beers Stella and Heineken, the PLI for alcoholic beverages is used.[8] For the products that do not fall into any of the PLI categories, the PLI category 'other food' is used.

To capture potential horizontal cross-country consumer food preferences, two 'distance' indices are created using a principal component analysis (PCA) technique for the countries included in the study.[9] First, a dietary index is estimated, using the current consumption of various food groups. The estimation uses data from the Global Dietary Database, which provides per person consumption of various food products, for each country, in 2015. The food groups included in the index are fruits, non-starchy vegetables, beans and legumes, nuts and seeds, unprocessed red meats, sugar-sweetened beverages, fruit juices, milk and protein. This index aims to capture preferences in current consumption patterns (Drewnowski & Hann, 1999).

The second index (attitude) is estimated using variables concerning consumer attitudes towards different product characteristics. The attitude index uses data from Eurobarometer reports, Eurostat and the World Bank. The Eurobarometer report includes questions regarding the importance of various product characteristics in consumer purchasing decisions. The index also considers the share of consumers that consider whether a product is organic, has known country of origin, or respects local tradition and 'know-how" as being important to their purchasing decision (European Commission, 2018a). As age and education level may affect consumer attitudes (Rani, 2014; Bailey & Pineres, 1997), the index also includes variables on the share of people aged 20-35 and the share of people with a bachelor's degree, data on which are obtained from Eurostat for 2018. Finally, access to information may also influence attitudes, and for this reason the share of people with access to the internet within a country in 2018 is also considered in the second index (Ceccoli & Hixon, 2012).

Figure 3 shows the values of the two indices for the MS included in the study.[10] The attitude index (the left panel in Figure 3) shows that MS in the southern EU tend to have more similar attitudes towards food than MS in the more northern part of the EU. A less clear pattern is seen in the dietary index (the right panel in Figure 3). Note that the indices are added in equation (1) as dereferences in their values between country pairs: Δ*Dietary index* and Δ*Attitude index*.

Figure 3. Distribution of the attitude and dietary index by country



Source: Authors' own estimation based on various data sources.

[8] The categories with available PLIs are alcoholic beverages; non-alcoholic beverages; oils and fats; fruits, vegetables and potatoes; bread and cereals; milk, cheese and eggs; and other foods.
[9] The indices are constructed using the first principal component.
[10] Note that the estimated indices allow for comparison between attitudes and dietary patterns across the MS included in the study, but an interpretation of the absolute value of the indices is meaningless.

3.2 Production and country-specific factors

In addition to variables related to consumer demand, specific characteristics of brand owners and products (production factors, PF_k) may affect a firm's incentive to use DC-SIP practices. An important determinant of DC-SIP could be related to the size of brand owner. For example, larger companies (multinationals) can divide the fixed cost of product development among several markets, may be in a better position to benefit from global brand reputation, and may be in a position to maintain a greater product portfolio and to access more markets (Russo, Menapace, & Sansone, 2020; Brambilla, 2009). The combination of these factors may entail different behaviour by larger companies with respect to DC-SIP compared with smaller ones. For this reason, a dummy variable – *company turnover > 22 billion* – is included in the estimated model. This takes the value 1 if company turnover is greater than 22 billion euros, and 0 otherwise. The data on company turnover are from European Commission (2018c).

Companies may have less incentive to create different versions of less complex products, given the lower degree of freedom to create a new version. For products containing more ingredients, firms have a greater range of choice in adapting products to a local market. Also, as products may be produced at several plants around the world, sourcing of an identical bundle of ingredients across various plants may be more challenging for a firm as the number of ingredients increases. Accordingly, a dummy variable – *product ≤ 3 ingredients* – is included in the estimated equation (1), taking the value 1 if a product contains three ingredients or fewer, and 0 otherwise.

Furthermore, as products sold in the EU may originate from various production plants, products emerging from the same manufacturing plant may be more likely to have a similar set of ingredients. Ideally, one would include the actual production plant as a variable for the analysis, but as there are no data on manufacturing plant locations and their sourcing destination for all country and product combinations, variables on the distance between the country pair – *distance* – and whether MS share a border – *shared border* – are included in equation (1). This assumes that products sold in countries closer to each other are more likely to be sourced from the same plant. The data for these variables are extracted from the gravity trade dataset provided by CEPII.

As firms are required to print the label of a product in the country's official language, a firm might prefer to keep the same packaging and composition if it sells a given branded product in two countries that have a common official language. Therefore, a dummy variable – *shared official language* – is included, taking the value 1 if the country pair has the same official language, and 0 otherwise.

In line with the EU wide testing campaign (European Commission, 2019b), two dummy variables – *similar packaging* and *different packaging* – are also considered, to account for differences in front-of-pack between versions of a product. The dummy *similar packaging* takes the value 1 if the front-of-pack is similar between product versions, and 0 otherwise. The dummy *different packaging* takes the value 1 if the front-of-pack is different between product versions, and 0 otherwise. The reference for the two dummies is identical front-of-pack. Difference in front-of-pack between a country pair is expected to result in higher probability of occurrence of DC-SIP between these countries.

Product category dummies are included as a control for potential structural factors/characteristics (e.g. type of ingredients, sourcing options, type of technology) that might impact the use of DC-SIP practices in a similar way across different branded products belonging to the same category. Similarly, country dummies are included to capture potential MS-specific factors (CF_j and CF_i), such as differences in competition environments, technologies, national regulations and institutions.

3.3 Descriptive statistics

The final dataset contains 19 different MS, 117 unique country-pair combinations, and 127 products, which amounts to 7,848 observations. The summary statistics are provided in Table 3.

Table 3. Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Occurrence of DC-SIP between country pairs	7,848	0.426	0.495	0.000	1.000
Consumer factors					
ΔGDP per capita (in 1,000s)	7,848	12.246	9.714	0.000	40.800
ΔDietary index	7,848	0.957	0.860	0.007	3.999
ΔAttitude index	7,848	0.996	0.838	0.015	3.871
ΔPrice level	7,848	20.112	17.612	0.000	97.200
Production factors					
Shared official language	7,848	0.002	0.046	0.000	1.000
Shared border	7,848	0.141	0.348	0.000	1.000
Log (Distance)	7,848	6.938	0.593	5.195	8.080
Company turnover > 22 billion	7,848	0.527	0.499	0.000	1.000
Product ≤ 3 ingredients	7,848	0.178	0.382	0.000	1.000
Packaging					
Similar packaging	7,848	0.321	0.467	0.000	1.000
Different packaging	7,848	0.148	0.355	0.000	1.000

4 Results

The results of the Probit estimations are provided in Table 4. The reported coefficients are the average marginal effects (AMEs), which indicate the average change in probability of the occurrence of DC-SIP between MS pairs when explanatory variable increases by one unit. The results from the full sample are presented in column 1. The results presented in column 2 exclude products with identical composition from the analysis, in order to examine whether this subset of the sample affects the estimated results.

The results reported in column 1 (Table 4) indicate that a greater difference in income (GDP per capita) for a country pair increases the probability of the composition of seemingly identical branded products differing between these countries. These results are statistically significant at 1% significance level. In other words, the results suggest that the occurrence of DC-SIP is more likely between MS with higher income differences than between MS with lower income differences. Column 2 shows the results when products identical across all MS are excluded from the sample. As these products are offered in an identical version in all MS, their exclusion from the sample is expected to increase the magnitude of the estimated coefficient (AME) as compared with the full sample. This is confirmed in Table 4: the estimated coefficient corresponding to the difference in income variable is greater in column 2 than in column 1 (0.00526 vs 0.00302).

To further explore the impact of the income variable on DC-SIP, Figure 4 shows the predicted probabilities of different product versions in a country pair, depending on various values of income differences between MS (i.e. *ΔGDP per capita*), calculated based on results reported in Table 4. As indicated in panel a) of Figure 4 (full sample), if the two countries have identical income levels, the predicted probability that the product versions offered in these two countries are different is 39%. As the income difference increases, the probability of the occurrence of DC-SIP between the country pair increases. For the country pair with the greatest income difference, Denmark/Bulgaria, the predicted probability of a product being different is 52%. The predicted probability of a product being different for a given country pair is greater when excluding identical products from the sample (shown in Figure 4 panel b). In this case, the probability of observing different product versions in a country pair with identical income levels is around 55%, increasing to around 75% for the country pair with the highest income difference (Denmark/Bulgaria).

The variable *ΔPrice level* aims to account for differences in price level between country pairs. Although the coefficients are positive and statistically significant for all four model specifications, the magnitudes of the coefficients are relatively small. This implies that the probability of the presence of DC-SIP between country pairs increases the greater the difference in price level between countries, but that this effect is fairly minor (Table 4).

Two variables are included to control for cross-country differences in consumer preferences: dietary index and attitude index. The attitude index is statistically insignificant in all model specifications. By contrast, differences in current diet (Δ *Dietary Index*) are positive and statistically significant, implying that a greater difference in diet between countries increases the probability that a firm offers different product versions (Table 4).

Except for the variable for a shared border, the variables controlling for differences in production factors are all statistically significant. As the distance between the two MS increases, the probability that the versions are identical decreases. This relationship is expected, as products sold in MS farther apart are less likely to come from the same production plant. If a product is produced by a company with turnover greater than 22 billion euros, the probability of a product being different between the country pair increases by around 6-8%, depending on the model specification. Similarly, less complex products – those with three ingredients or fewer – are about 25% less likely to be different for a given country pair (full sample) and 14% less likely (restricted sample). A shared official language reduces the probability of different versions being sold in a given country pair by 4.8% in the full sample, but this effect becomes statistically insignificant when considering the restricted sample (Table 4).

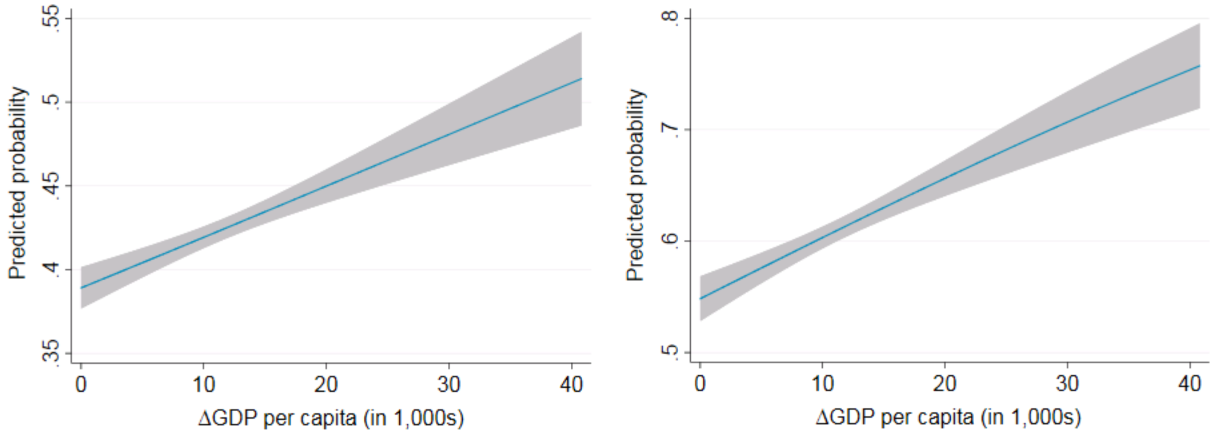
Table 4. Regression results

VARIABLES	**Full sample** (1)	**Excluding products with identical content** (2)
Δ GDP per capita (in 1,000s)	0.00302***	0.00526***
	(0.00047)	(0.00074)
Δ Price level	0.00088***	0.00117**
	(0.00034)	(0.00048)
Δ Dietary Index	0.02425***	0.04045***
	(0.00642)	(0.00980)
Δ Attitude Index	0.00311	0.00109
	(0.00675)	(0.01003)
Shared official language	-0.04833*	-0.03021
	(0.02527)	(0.03719)
Shared border	0.02659	0.03781
	(0.01688)	(0.02623)
Log (Distance)	0.05241***	0.08263***
	(0.01121)	(0.01567)
Company turnover > 22 billion euros	0.07927***	0.06042***
	(0.00853)	(0.01149)
Product ≤ 3 ingredients	-0.24984***	-0.13908***
	(0.01923)	(0.03474)
Similar packaging	0.22434***	0.15930***
	(0.01060)	(0.01597)
Different packaging	0.36969***	0.33118***
	(0.01380)	(0.01656)
R^2	0.2595	0.1386
Observations	7,848	5,459

Standard errors are clustered at country-pair level. Dummies are included for various product categories and for each individual country.

*** p<0.01, ** p<0.05, * p<0.1

Figure 4. Predicted probabilities, by difference in income level



a) Full sample **b)** Excluding products with identical composition

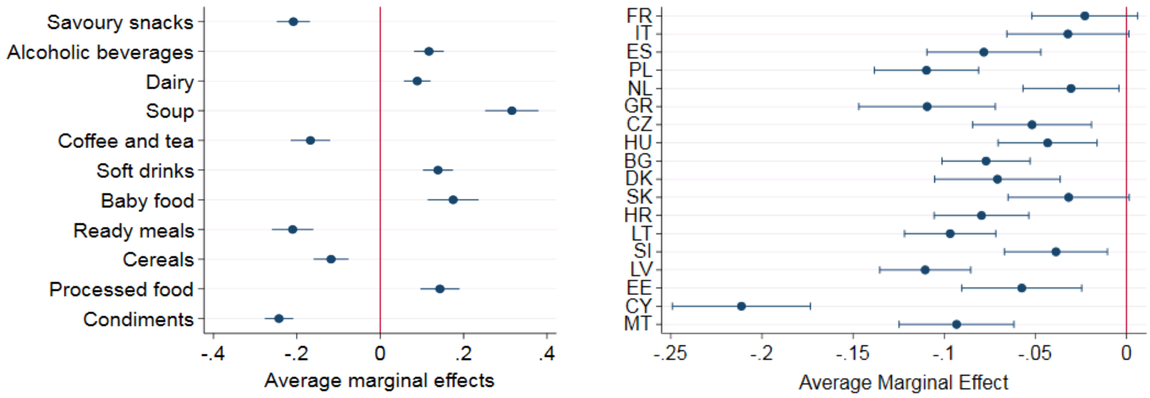
Note: The predicted probabilities in Figure 4 a) and 4 b) correspond to the regression in columns 1 and 2 in Table 4, respectiveley . The shaded area corresponds to a 95% confidence interval.

The estimated coefficients corresponding to the dummy variables accounting for differences in front-of-pack are statistically significant across all estimated models (Table 4). As expected, greater difference in front-of-pack (i.e. estimated coefficients for the *similar packaging* variable are lower than coefficients for the *different packaging* variable) entails higher probability of the presence of DC-SIP. Compared with a product with identical front-of-pack, a product with similar packaging is around 16-22% more likely to be offered in different versions, while products with different front-of-pack are around 33-37% more likely to have different versions between country pairs.

The specific characteristics of different product categories may affect a company's ability to produce several versions of a product. The estimation shown in Table 4 included dummies for various product categories. Figure 5 panel a) shows the estimated coefficients (AMEs) corresponding to product category dummies for the model specification shown in Table 4 column 1. The reference category is confectionery. Thus, all the other AMEs are compared with this product category, i.e. whether DC-SIP is more or less likely to be present for a given category compared with confectionery products. As displayed in Figure 5 panel a), products in the categories savoury snacks, coffee and tea, ready meals, cereals, and condiments are less likely to be offered in different versions between MS than confectionery. Alcoholic beverages, dairy, soup, soft drinks, baby food, and processed food are, on the other hand, more likely to be offered in different versions than confectionery.

The estimations in Table 4 also control for country-specific factors – such as national regulations and the nature of competition within a country – by including MS dummies in the regressions. Figure 5 panel b) shows the AMEs for MS dummies corresponding to the results of the model specification from Table 4 column 1. The reference MS, with which AMEs for other MS are compared, is Germany. Note that MS are sorted by total population in Figure 5 panel b). As shown in Figure 5 panel b), all the AMEs have a negative coefficient, which implies that if Germany is one of the countries in a given country pair, it increases the probability of different versions compared with other country pairs. Except for France, Italy, and Slovakia, the AMEs are significantly lower than for Germany. Moreover, if Cyprus is one of the countries in the country pair, it significantly lowers the probability of different versions in a given country pair. This may be due to Cyprus being a smaller country, and thus it is less beneficial for companies to create a separate version.

Figure 5. Average marginal effects, by product category and Member State



a) Product group AMEs

b) Member state AMEs

Note: the AMEs correspond to the regression in Table 4 column 1. The figure shows the AMEs with a 95% confidence interval. The reference food group in panel a) is confectionery and the reference MS in panel b) is Germany.

4.1 Robustness analyses

Two robustness checks are performed, to investigate whether the results in Table 4 (full sample) still hold if a more restricted dataset is considered in estimations. The first robustness check is based on an estimation of equation (1) that excludes country pairs in which the product versions have a different front-of-pack, as defined in the European Commission (2019b) study. The second robustness check is performed by excluding products with similar content from the analysis. The reason for the first robustness check is that one can argue that products with different packaging could be considered as different products, so it may not be informative or relevant to include them in the estimations. The reason for the second robustness check is that products having similar composition could be due to various factors that may or may not represent DC-SIP practice, depending on the situation. For instance, companies argue that in some cases smaller differences could ‘result from the application of different rounding rules for the nutrition declaration’ (European Commission, 2019b).

The results of excluding different packaging are shown in Table 5. The estimations confirm that results in Table 4 (full sample) are robust, both to excluding products with different packaging (Table 5 column 1) and to excluding products with similar composition (Table 5 column 2). The estimated coefficient for *ΔGDP per capita* does not substantially vary compared with the other coefficients reported in Table 4. In general, the estimated coefficients of the explanatory variables in Table 5 are of the same sign as the estimates in Table 4. Magnitude and statistical significance are also similar in both cases. The exception is the coefficients associated with the *shared official language* variable, which are insignificant in the robustness check when excluding products with a similar composition (Table 5 column 2), but significant in Table 4 (full sample).

Table 5. Robustness checks

VARIABLES	Excluding products with different packaging (1)	Excluding products with similar composition (2)
Δ GDP per capita (in 1000s)	0.00333***	0.00259***
	(0.00053)	(0.00050)
Δ Price level	0.00101***	0.00073**
	(0.00037)	(0.00032)
Δ Dietary Index	0.02639***	0.02410***
	(0.00698)	(0.00574)
Δ Attitude Index	0.00316	0.00509
	(0.00765)	(0.00636)
Shared official language	-0.14187***	-0.00318
	(0.02349)	(0.02493)
Shared border	0.02776	0.02555
	(0.01868)	(0.01635)
Log (Distance)	0.05024***	0.05859***
	(0.01246)	(0.01158)
Company turnover > 22 billion euros	0.09543***	0.06426***
	(0.01036)	(0.00863)
Product ≤ 3 ingredients	-0.25554***	-0.24886***
	(0.02031)	(0.01861)
Similar packaging	0.21672***	0.24342***
	(0.01086)	(0.01099)
Different packaging		0.41284***
		(0.01334)
	0.2121	0.2917
Observations	6,687	7,323

Standard errors are clustered at country-pair level. Dummies are included for various product categories and for each individual country.

*** p<0.01, ** p<0.05, * p<0.1

5 Conclusions

This report provides an econometric analysis of the economic determinants of differences in the composition of seemingly identical branded food products (DC-SIP) in the European Union. The analyses of this report build on the results from the EU wide testing campaign conducted on 127 branded products, in 19 Member States, between 6 November 2018 and 7 January 2019 (European Commission, 2019b). This information is combined with economic data, which are considered in econometric estimations in order to identify economic drivers of DC-SIP.

The estimated results show that a greater difference in income level between two MS increases the probability that the two MS have different versions of seemingly identical branded food products. The analyses of this report also show that, although the income difference among two MS is a driver for DC-SIP, other factors – such as heterogeneous consumer preferences across MS, distance between MS, company size, price level and product complexity – also contribute to a firm's incentive to offer different versions of seemingly identical branded food products in different MS. Specific characteristics of different product categories and country-specific factors are also found to impact the presence of DC-SIP between MS. These results were found to be robust to different considerations relating to the dataset considered in the econometric estimations.

A potential caveat for the analysis conducted in this report is that DC-SIP is defined as seemingly identical branded products with differences between MS in either ingredients or nutrient content. Although some branded products included in the report might not have different composition across MS, based on this definition of DC-SIP, some of them may however differ in characteristics (e.g. in variety of ingredients). This could be the case even for branded products with few ingredients – although they were found in this report to be less likely to be subject to DC-SIP – if the ingredient varies between product versions sold across different MS. Indeed, tests conducted in some MS found that some branded products (including ones with few ingredients) were different in texture or taste (Borzan, 2017; CEU, 2017; Croatian Food Agency, 2017; European Commission, 2019b; European Parliament, 2017; Jancarikova, 2017; MPSR, 2017; Néhib, 2017; SZPI, 2015). This may be due to differences in the quality of the ingredients, rather than differences in the variety of ingredients. The definition of DC-SIP applied in this report does not capture potential differences in input quality between different versions of seemingly identical branded food products. To conduct economic analyses taking product quality into consideration, data would need to be available across branded products and MS, with sufficient sample size to be able to derive statistically robust estimates.

References

Bailey, W., & Pineres, S. A. (1997). Country of origin attitudes in Mexico: the malinchismo effect. *Journal of International Consumer Marketing, 9*, 25-41.

Borzan, B. (2017). *Istraživanje kvalitete naizgled istih proizvoda na tržištima starih i novih država članica EU.* Retrieved from https://www.jutarnji.hr/vijesti/hrvatska/istrazivanje-kvalitete-naizgled-istih-proizvoda-na-trzistima-starih-i-novih-drzava-clanica-eu/6510

Brambilla, I. (2009). Multinationals, technology, and the introduction of varieties of goods. *Journal of International Economics, 79*, 89-101.

Cameron, A. C., & Trivedi, P. K. (2005). *Microeconometrics: methods and applications.* Cambridge university press.

Ceccoli, S., & Hixon, W. (2012). Explaining attitudes toward genetically modified foods in the European Union. *International Political Science Review, 33*, 301-319.

CEU. (2017). *Experience of certain EU Member States with dual quality of foodstuffs in free movement within the EU.* Council of the European Union. Retrieved from http://data.consilium.europa.eu/doc/document/ST-6716-2017-INIT/en/pdf

Colen, L., Chryssochoidis, G., Ciaian, P., & Di Marcantonio, F. (2020). *Differences in composition of seemingly identical (DC-SI) branded products: Impact on consumer purchase decisions and welfare.* JRC Technical Report, European Commission.

Council of the European Union. (2016). *Dual quality of foodstuffs on the EU common market.* Brussels: Council of theEuropean Union. Retrieved from http://data.consilium.europa.eu/doc/document/ST-8754-2016-INIT/en/pdf

Cranfield, J., Henson, S., & Blandon, J. (2012). The effect of attitudinal and sociodemographic factors on the likelihood of buying locally produced food. *Agribusiness, 28*, 205-221.

Croatian Food Agency. (2017). *Quality research of (seemingly) identical products on the markets of old and new EU member states.* Osijek. Retrieved from https://www.hah.hr/wp-content/uploads/2015/10/Dual-quality-final-report.pdf

Di Comite, F., Thisse, J.-F., & Vandenbussche, H. (2014). Verti-zontal differentiation in export markets. *Journal of International Economics, 93*, 50-66.

Drewnowski, A., & Hann, C. (1999). Food preferences and reported frequencies of food consumption as predictors of current diet in young women. *The American journal of clinical nutrition, 70*, 28-36.

European Commission. (2017). *President Jean-Claude Juncker's State of the Union Address 2017.* Brussels: European Commission. Retrieved from https://ec.europa.eu/commission/presscorner/detail/en/SPEECH_17_3165

European Commission. (2018a). *Special Eurobarometer 473: Europeans, Agriculture and the CAP.* Tech. rep., European Commission.

European Commission. (2018b). *Framework for selecting and testing of food products to assess quality related characteristics: EU harmonised testing methodology.* Joint Research Centre, European Commission, https://ec.europa.eu/knowledge4policy/publication/.

European Commission. (2018c). *Note to file: Assessment of an extension of the protection of the UTP directive to undertakings with turnovers of € 150 million and € 350 million.* Brussels.

European Commission. (2019a). *Directive (EU) 2019/2161 of the European Parliament and of the Council of 27 November 2019 amending Council Directive 93/13/EEC and Directives 98/6/EC, 2005/29/EC and 2011/83/EU of the European Parliament and of the Council.* Official Journal of the European Union.

European Commission. (2019b). *Results of an EU wide comparison of quality related characteristics of food products.* Publications Office of the European Union.

European Parliament. (2013). *Resolution on a New Agenda for European Consumer Policy.* Official Journal of the European Union. Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52013IP0239&from=EN

European Parliament. (2017). *Dual quality of branded food products Addressing a possible east-west divide.* Briefing, European Parliament, https://www.europarl.europa.eu/RegData/etudes/BRIE/2017/607265/EPRS_BRI(2017)607265_EN.pdf.

European Parliament. (2018). *Quality Differences in Consumer Products in the EU Legislation: Study.* European Parliament. Retrieved from https://www.europarl.europa.eu/RegData/etudes/STUD/2018/608840/IPOL_STU(2018)608840_EN.pdf

Gracia, A., & De Magistris, T. (2008). The demand for organic foods in the South of Italy: A discrete choice model. *Food Policy, 33*, 386-396.

Inderst, R., & Shaffer, G. (2007). Retail mergers, buyer power and product variety. *The Economic Journal, 117*, 45-67.

Jancarikova, T. (2017). *East Europeans decry "double standards" for food, seek change to EU law.* Hamburg, Austria: Reuters.

MPSR. (2017). *Záverečná správa porovnania kvality potravín v Rakúsku a na Slovensku.* MPSR. Retrieved from http://www.mpsr.sk/download.php?fID=12627

Néhib. (2017). *Kiadvány a Magyarországon és külföldön forgalmazott élelmiszerek 2017. évi összehasonlító vizsgálatának tapasztalatairól.* Retrieved from https://portal.nebih.gov.hu/documents/10182/323140/03.29_Terme%cc%81k-o%cc%88sszehasonli%cc%81ta%cc%81s_kiadv%c3%a1ny

Rani, P. (2014). Factors influencing consumer behaviour. *International Journal of Current Research and Academic Review, 2*, 52-61.

Russo, C., Menapace, L., & Sansone, M. (2020). *Economic rationale behind differences in the composition of seemingly identical branded food products in the Single Market.* JRC Technical Report, European Commission.

Saitone, T. L., & Sexton, R. J. (2010). Product differentiation and quality in food markets: industrial organization implications. *Annu. Rev. Resour. Econ., 2*, 341-368.

Schmid, S., & Kotulla, T. (2011). 50 years of research on international standardization and adaptation—From a systematic literature analysis to a theoretical framework. *International Business Review, 20*, 491-507.

SZPI. (2015). *Potraviny a Český spotřebitel.* Státní zemědělská a potravinářská inspekce. Retrieved from https://www.szpi.gov.cz/soubor/zprava-z-vyzkumu-potraviny-a-cesky-spotrebitel.aspx

Valli, C., & Traill, W. B. (2005). Culture and food: a model of yoghurt consumption in the EU. *Food quality and preference, 16*, 291-304.

Zepeda, L., & Li, J. (2007). Characteristics of organic food shoppers. *Journal of Agricultural and Applied Economics, 39*, 17-28.

List of abbreviations and definitions

AME	Average marginal effect
DC-SIP	Differences in composition of seemingly identical branded food products
EU	European Union
GDP	Gross domestic product
LPM	Linear probability model
MS	Member States
PCA	Principle component analysis
PLI	Price level index
WTP	Willingness to pay

List of figures

List of tables

GETTING IN TOUCH WITH THE EU

In person

All over the European Union there are hundreds of Europe Direct information centres. You can find the address of the centre nearest you at: https://europa.eu/european-union/contact_en

On the phone or by email

Europe Direct is a service that answers your questions about the European Union. You can contact this service:

- by freephone: 00 800 6 7 8 9 10 11 (certain operators may charge for these calls),

- at the following standard number: +32 22999696, or

- by electronic mail via: https://europa.eu/european-union/contact_en

FINDING INFORMATION ABOUT THE EU

Online

Information about the European Union in all the official languages of the EU is available on the Europa website at: https://europa.eu/european-union/index_en

EU publications

You can download or order free and priced EU publications from EU Bookshop at: https://publications.europa.eu/en/publications. Multiple copies of free publications may be obtained by contacting Europe Direct or your local information centre (see https://europa.eu/european-union/contact_en).

KJ-NA-30023-EN-N

The European Commission's science and knowledge service

Joint Research Centre

JRC Mission

As the science and knowledge service of the European Commission, the Joint Research Centre's mission is to support EU policies with independent evidence throughout the whole policy cycle.

EU Science Hub
ec.europa.eu/jrc

@EU_ScienceHub

EU Science Hub - Joint Research Centre

EU Science, Research and Innovation

EU Science Hub

Publications Office of the European Union

doi:10.2760/184019

ISBN 978-92-76-14245-4