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Global economic crisis impact on organic food consumption in the Czech Republic

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Introduction: This study investigates the impact of the global economic crisis of 2008 on organic food consumption in the Czech Republic. The structure of this study includes general consumption attitudes and consumption of individual organic food items (organic milk). The goal of this study is to quantify the influence of selected income macroeconomic indicators on organic food consumption (in general and individually). This study is focused on analyzing how this impact changed after 2008 in both prospectives.

Methods: Methodologically, the error correction methodology (ECM) has been applied. However, it has been modified to incorporate breakpoint analysis to model the impact of the global economic crisis on organic food consumption. Thus, the total consumption of organic food and consumption of organic milk has been investigated.

Results: Econometric verification of the estimated model proved that there was a statistically significant positive dependence of both indicators of organic food consumption on all the investigated indicators of income before 2008. Nonetheless, it was also proved that this dependence disappeared after the global economic recession in 2008. This retrospective analysis provides a valuable view of the mechanisms of organic food consumption changes caused by economic crises.

Discussion: Prospective repetition of the research with the data from the current crisis could enrich the theory of organic food consumption. On the one hand, the results of hypotheses testing could be verified, and thus, the mechanisms of consumer reactions to the crisis could be identified, and the model of reaction to the next crisis cycle could be developed so as not to harm radically this sector. On the other hand, the results of hypothesis testing could be denied, and thus, the evolution in organic food perception and consumption could be stated. In this case, the need to revise the so-far formulated theoretical approaches would be proved.

KEYWORDS

organic food, organic food consumption, organic milk, organic milk consumption, consumption function, income, economic crisis, error correction model

1 Introduction

Organic farming and organic food production are becoming increasingly important in the Czech Republic. Consumer interest in organic food is deepening, and more farmers are beginning to specialize in organic food production (Rypakova et al., 2015). Between 2005 and 2008, the market for organic food in the Czech Republic grew significantly. The subsequent period, 2009–2010, showed stagnation due to the global economic crisis, but since 2011, a long-term upward trend has started again. Hlavackova and Svobodova (2020) report that since 2011, the organic food market has experienced an annual increase in the consumption of organic food for the 10th year. Between 2012 and 2013, consumption of organic food increased

by 9.5% year-on-year. In 2014, consumption grew by 3.9%, exceeding the CZK 2 billion. In 2015–2016, the organic food market grew at a rate of 11 and 14% year-on-year, and even at a rate of 30.5 and 33% in 2017–2018. In 2019, a 19% growth was recorded, and in 2020, marked by government measures to prevent the spread of COVID-19, organic food consumption grew by 14%. The importance of the organic food market is growing globally, and this growing trend is also observed in the scientific literature (Lazaroiu et al., 2019; Majerova et al., 2020; Sabau et al., 2023). The consumer demand for conventional and bio-milk in Sweden is investigated by Lindstorm (2022). The difference between consumer demand for conventional and bio-milk is analyzed in Ohio, United States, by Chang et al. (2011). They concluded that the sensitivity of demand for bio-milk to price changes depends on whether one is a suburban or inner-city resident. Maksan et al. (2022) analyzed the consumer demand for organic yogurt in Croatia, considering health concerns, nutritional value, and food safety as the main drivers of this demand. Thogersen (2010) addressed the issue of the long-term sustainability of organic food consumption and analyzed the reasons for differences between countries. His findings are in line with the expectation that the share of organic food consumption in total food consumption depends significantly on policy regulation (the legal definition of organic food standards), financial support to farmers, and a national organic food labeling system. He considers other important factors to be the land factor, an efficient distribution system, the price premium for organic food, food consumption habits in the country, and environmental care.

The regional approach to the issue, which is in contrast to the global character of this trend in consumption, is connected with the importance of national psychographic specifics of consumers (Chen et al., 2018). While on the one hand, internal motivation sources of the consumption are traditionally perceived as a reason for a regional approach, on the other hand, income is considered as a macro factor with an objective impact on the willingness to pay and its regional character is not taken into account (Garbarova et al., 2017; Gajanova et al., 2019, 2020). The importance of a regional approach in economy and management has already been verified by Nadanyiova (2014a,b). However, in light and shadow of the theory of mental accounting, created by R. Thaler, income should not be treated generally, and its psychographic character should be considered as significant. Thus, the national approach to the consumption of organic products and its research are also relevant when the income impact on consumption is analyzed. This fact has already been realized by Olivas et al. (2013), who provided research focused on the analysis of the relationship between income and consumption of organic food in specific conditions in Spain. They have found out that low-income consumers are more concerned about eating a healthy diet than those with higher incomes. Based on this finding, the original presumption that there is a positive correlation between income and attitudes toward organic consumption has been destabilized, and the space for fulfilling the scientific gap has been created. However, relevant, robust macroeconomic research on this phenomenon has not been realized until now. In light and shadow of above-mentioned, the research question can be formulated. The purpose of our research is to answer the question of whether there is an impact of macroeconomic indicators on organic food consumption in the Czech Republic. Thus, the research gap would be filled from a regional perspective, and the platform for further research in this area would be developed. The study is divided into several chapters, which are individually focused on (1) the current state of knowledge in the scope of organic food consumption; (2) the methodological background of own research; (3) the presentation of own results; and (4) the discussion of own results based on their constructive comparison with the current state of knowledge summarized in the first chapter of this study.

2 Literature review

In the Czech Republic, Zivelová and Jansky (2006) discuss the possibility of developing the organic food market. They see obstacles for further development both on the demand side (insufficient consumer awareness of the quality of organic food and their reluctance to pay a higher price for it) and on the supply side (insufficient processing capacity). The development of organic agriculture in the Czech Republic is significantly supported by government institutions. The Ministry of Agriculture of the Czech Republic (2021) issued the Action Plan of the Czech Republic for the Development of Organic Agriculture in 2021–2027, which aims to achieve a 4% share of organic food in the total consumption of food and beverages by 2027, compared to 1.52% in 2020.

The literature on organic food is dominated by studies on consumer behavior (Nadanyiova and Kramarova, 2013). Hansen et al. (2018) developed a psychological model of consumer behavior in the organic food sector based on consumers' values and motives. Thogersen and Olander (2006) describe the relationship between the attitudes and norms of consumers in Denmark and their consumer behavior in relation to the purchase of organic food. Oraman and Unakitan (2010) analyze the factors influencing the purchase of organic fruits and vegetables in Istanbul, Turkey, concluding that consumers' concern for their health and food safety is the main factor influencing consumer preference toward organic food.

The literature is very heterogeneous in the scope of the question of the income dependence of organic food consumption (Kicova and Nadanyiova, 2015; Krizanova et al., 2015; Jankalova and Vartiak, 2017). Chen et al. (2022) analyzed the demand for dairy organic food in the US in terms of socio-demographic factors. Among other things, they find that households substitute conventional milk for organic milk as their income increases. A similar conclusion regarding the income dependence of bio-milk consumption was reached by Xu et al. (2016), who discussed the issue of Chinese consumers' willingness to pay a higher price for bio-milk depending on age, gender, education, and income. One of their conclusions is that disposable income is an important factor influencing the willingness to pay a higher price. Consumer demand for organic food in China is analyzed by Yin et al. (2010). The main results of their investigation include that purchases of organic food are significantly influenced by income, trust in organic food, the degree of acceptance of its higher price, and consumers' concern for their health. Petljak et al. (2017) seek to identify the significant factors influencing the willingness of consumers in the Czech Republic and Croatia to pay a higher price for organic food. Among other things, they conclude that one of these important factors is household income. In contrast, Aschemann-Witzel and Zielke (2017), who examine the effect of income and the effect of price and its change on consumer demand for organic food, concluded that income plays only a negligible role compared to psychological factors.

The cited literature examining the relationship between organic food consumption and income has focused on microeconomic analysis

of individual households, usually based on data from questionnaire surveys. Macroeconomic analysis of the relationship between organic food consumption and income is virtually absent from the literature. A rare exception is the study by Liu et al. (2019), in which the authors analyze interest in organic food globally using data obtained from the Google search engine, and one of their conclusions is that organic food consumption is not correlated with GDP.

The above-stated is also visible in the scope of Figure 1. There is a graphical outcome of the VOSviewer analytical tool of the bibliometric analysis presented. The analysis has been provided on the Web of Science platform, where the criteria for including the analysis have been set based on the mutual appearance of selected keywords in this study. These words were "organic food" and "income". In all the archives of the database, 120 articles met these criteria. Thus, the basic dataset for further bibliometric research has been created. It has been found that there are four groups of interest of scientists when the relationship between organic food and income is analyzed in the scope of the following:

- demographic specifics in attitudes toward income spending in favor of organic food products (shown blue),
- organic food products value sources, which reflect the price and willingness to pay for them (shown green),
- national and market specifics in terms of product category and country (shown red),
- overall consumer preferences dedicated to prospective value sources of organic food products (shown yellow).

However, the macroeconomic aspect of this relationship is missing at all.

This study aims to fill the gap in the literature on the analysis of the income dependence of organic food consumption. To this end, this dependence will be examined at the macroeconomic level using a time series of aggregate indicators. Specifically, to describe the statistical dependence of the aggregate indicator of organic food consumption on aggregate income, the Error Correction Model (ECM) is applied, which allows the examination of both the long-run equilibrium relationship between organic food consumption and income and the short-run dynamics. The standard ECM model is furthermore modified in this study to include a breakpoint analysis with respect to the global economic crisis of 2008. In the context of the statistical breakpoint analysis, a second important objective of the study is to investigate how the dependence of organic food consumption on income changed after 2008 in the context of the aforementioned global economic recession. To analyze the robustness of the results obtained, this study analyzes both the total consumption of organic food and the consumption of dairy organic food. In addition, to ensure the robustness of the results obtained, both GDP and gross disposable income are used as income.

3 Research design and context

The aim of this study is to investigate the dependence of organic food consumption on income indicators using aggregate time series. Specifically, annual time series for the time period 1993–2022 are used, and an aggregate indicator of both total consumption of organic food and consumption of dairy organic food *per capita* is examined. For robustness testing, different indicators will be chosen as the income indicator in different regression equations. Specifically, a time

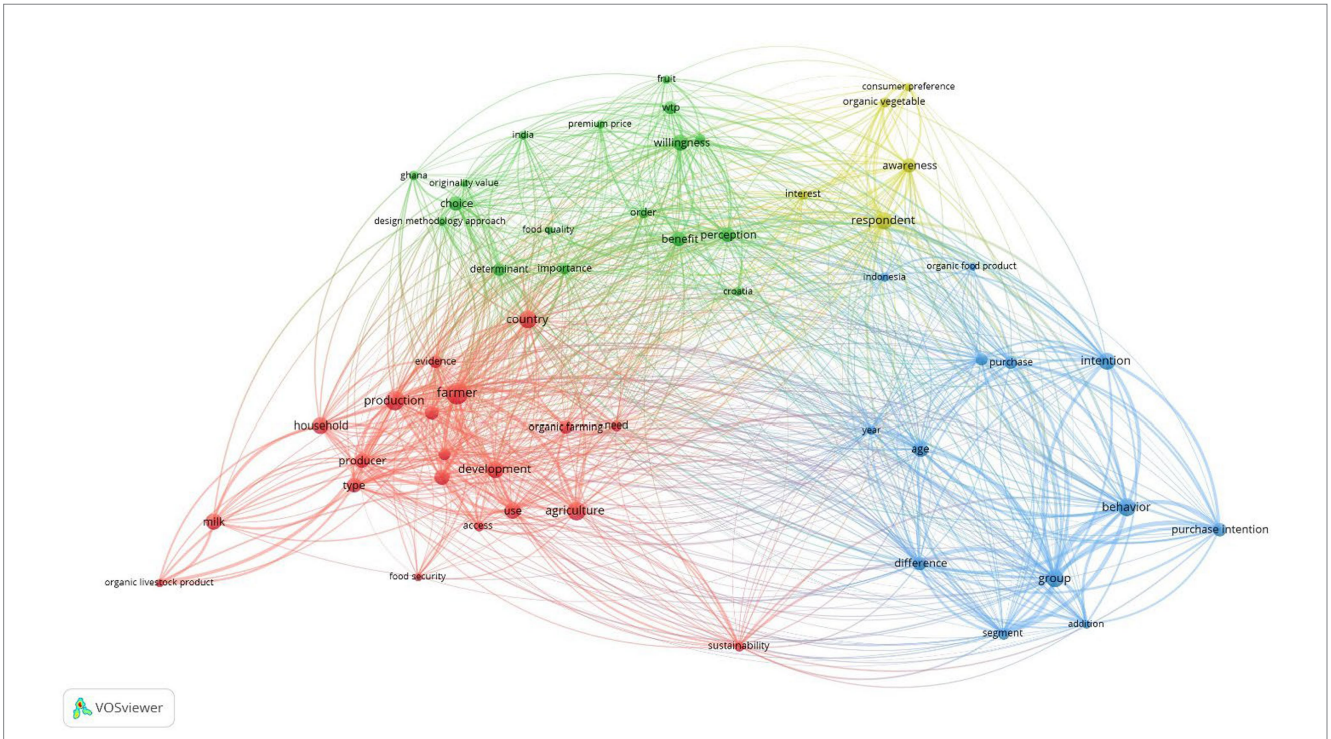


FIGURE 1
Bibliometric map identifying topics of interest in the scope of "organic food" and "income" articles in WoS database. Source: Own processing.

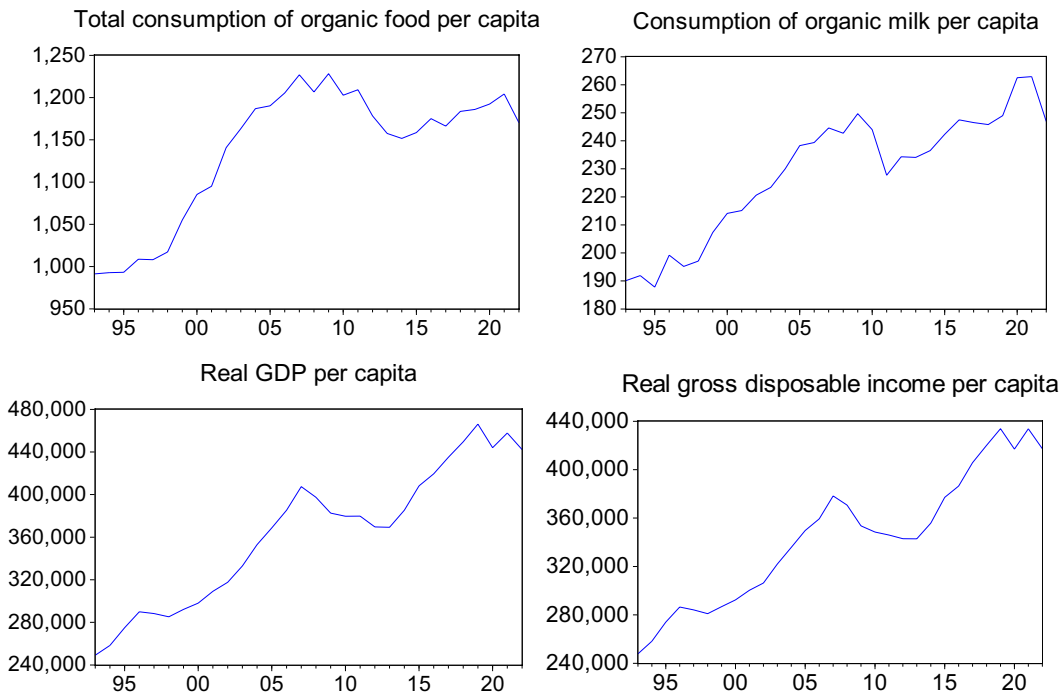


FIGURE 2
Evolution of the time series used to illustrate the 2008 turning point. Source: Own processing.

series of real GDP *per capita* is considered, as well as an indicator of real gross disposable income on a *per capita* basis. The source of these data is the database of the Czech Statistical Office (CZSO: Main Macroeconomic Indicators, 2023).

The mathematical description of the systematic aspects of the statistical relationship between real consumption of organic food and the selected indicators of real income was statistically analyzed using an error correction model. An error correction model is applied in this study for two reasons. First, all analyzed variables are non-stationary. Second, consumption and income are closely related in the long run due to budget constraints, from which it follows that these variables are cointegrated. Economic indicators with these two characteristics must be formulated as an error correction model (Engle and Granger, 1987). Moreover, as stressed by Jansen (1996), an error correction model can be regarded as a synthesis of other approaches focusing either only on the long-run relation (cointegration) or only on the short-term dynamics (regression models with differenced data).

Moreover, the presence of economic crises requires statistical breakpoint analysis to be applied. For this reason, instead of the commonly used ADF (Augmented Dickey-Fuller) tests (Dickey and Fuller, 1979) and Phillips-Perron tests (Phillips and Perron, 1988), the Perron (1989) stationarity test for time series with a breakpoint was employed. The breakpoint was statistically tested and demonstrated using Chow's (1960) stability test in all regression models used. The error correction model was therefore modified to include breakpoint analysis using auxiliary binary variables (Poliak et al., 2014).

The econometric estimation and testing of the error correction model with breakpoints was done using Engle and Granger's (1987) method. Dependent variables were chosen to be (1) total organic food consumption and (2) *per capita* consumption of dairy organic food. To examine the robustness of the results obtained, different income indicators were chosen as explanatory variables in different regression equations. Specifically, the indicator (1) of real GDP *per capita* and also the indicator (2) of real gross disposable income were considered.

4 Results

All time series used were tested for stationarity using the Perron (1989) test designed for time series with a breakpoint. The breakpoint was always set in 2008, given the outbreak of the global economic crisis in that year. The evolution of the time series used to illustrate the turning point at the outbreak of the global economic crisis is shown in the following figure (Figure 2).

The error correction model will be formulated in logarithms of the variables and in absolute differences of the logarithmic values. Therefore, the results of Perron's stationarity test of the time series are expressed for the logarithmic variables and their 1st differences. In the case of the original variables, the trend and level constants were used in the Perron test, and for the case of the differenced data, only the level constant was used in the test. The breakpoint was always set in 2008. The null hypothesis states that the relevant time series contains a unit root. The results are summarized in Table 1.[1]

The results in the table show that in all cases, the indifference data are non-stationary and also that transforming them using 1st differences has already ensured their stationarity. For this reason, an error correction model was chosen to model the relationship between

1 The symbols *, **, and *** indicate rejection of the null hypothesis at the 10, 5, and 1% significance levels, respectively.

TABLE 1 Results of Perron's stationarity test for the time series with a breakpoint in 2008.

Perron stationarity test		Undifferentiated data		1. differentiation of variables	
		Test criterion	*P*-value	Test criterion	*P*-value
Time series (in logarithms)	Real consumption of total organic food (*per capita*)	−0.52	≥ 0.5	−5.33	< 0.01***
	Real consumption of organic dairy foods (*per capita*)	−1.77	≥ 0.5	−6.66	< 0.01***
	Real GDP (per 1 inhabitant)	−0.08	≥ 0.5	−4.94	< 0.01***
	Real gross disposable income (*per capita*)	−2.47	≥ 0.5	−4.47	< 0.01***

Source: Own processing.

TABLE 2 Results of the stationarity test of the bias estimate $\hat{u}_t$ from long-run equilibrium using the ADF test.

Dependent and explanatory variable used		Test criterion	*P*-value
C_t…total consumption of organic food	Y_t…GDP	−2.58	0.012**
	Y_t…gross disp. Income	−2.69	0.009***
C_t…consumption of organic dairy foods	Y_t…GDP	−3.28	0.002***
	Y_t…gross disp. Income	−2.71	0.009***

Source: Own processing.

organic food consumption and a given income indicator to eliminate the problem of apparent regression in non-stationary time series and describe both the long-run equilibrium relationship between these variables and the short-run dynamics.

The error correction model will be formulated here with the dependent variable *total organic food consumption* and the explanatory variable *GDP*. A completely analogous model has also been formulated for all other combinations of dependent and explanatory variables.

The first step in the Engle and Granger (1987) methodology is the econometric estimation of the long-run equilibrium relationship between the original indifference variables (Eq. 1):

$$\ln(C_t) = \alpha_0 + \alpha_1 \cdot \ln(Y_t) + u_t, \quad (1)$$

Where C_t denotes the real total consumption of organic food in *per capita* terms,

Y_t represents real GDP *per capita*,

u_t is a random error with characteristics of the so-called white noise.

Due to the non-stationarity of the time series used, the econometric estimation of the regression equation is burdened with the problem of apparent regression. Parameter estimates $\hat{\alpha}$, $\hat{\beta}$ using the least squares method can therefore only be used to obtain an estimate of the deviation from the long-run equilibrium $\hat{u}_t$ (Eq. 2):

$$\hat{u}_t = \ln(C_t) - \hat{\alpha}_0 - \hat{\alpha}_1 \cdot \ln(Y_t). \quad (2)$$

To apply the error correction model, the variables of the model, $\ln(C_t), \ln(Y_t)$, need to be first-order cointegrated, i.e., the deviation from the long-run equilibrium $\hat{u}_t$ is stationary. In this case, stationarity was tested with the standard Augmented Dickey-Fuller (ADF) test, and the results are summarized in the following Table 2.

The results in the table show that the null hypothesis of the existence of a unit root of the variable $\hat{u}_t$ is rejected at the 5% significance level in all cases and even at the 1% significance level in three cases. Deviation from long-run equilibrium $\hat{u}_t$ is therefore a stationary variable in all cases considered, and the following error correction model can be applied (Eq. 3):

$$\Delta c_t = \beta_1 \cdot \Delta y_t + \beta_2 \cdot \hat{u}_{t-1} + \varepsilon_t, \quad (3)$$

Where

$$\Delta c_t \equiv \ln(C_t) - \ln(C_{t-1}),$$

$$\Delta y_t \equiv \ln(Y_t) - \ln(Y_{t-1}),$$

$\hat{u}_{t-1}$ represents the lagged deviation from the long-run equilibrium relationship,

ε_t is a random error with white noise properties.

Since the absolute difference of the logarithmic quantities corresponds approximately to the relative difference of the original non-logarithmic values $\ln(X_t) - \ln(X_{t-1}) \cong \frac{X_t - X_{t-1}}{X_{t-1}}$, the coefficients β_1, β_2 interpret the coefficients of relative elasticity. Parameter β_1 thus expresses by how much percentage C_t change if the value of Y_t changes by 1%. Similarly, the parameter β_2 indicates by how much percent it will change C_t if this consumption was 1% above its long-run equilibrium level in the previous period.

The standard error correction model (3) was tested for stability using Chow's (1960) breakpoint test (Table 3). The application of this statistical test showed a breakpoint at the 5% level of statistical

TABLE 3 Results of Chow's breakpoint test in 2008 for the error correction model (3).

Dependent and explanatory variable used		Test criterion (*P*-value)		
		F-statistics	Logarithm of the likelihood ratio	Wald's statistics
C_t…total consumption of organic food	Y_t…GDP	22.09 (0.000)***	29.79 (0.000) ***	44.19 (0.000)***
	Y_t…gross disp. Income	27.23 (0.000)***	33.89 (0.000) ***	54.46 (0.000)***
C_t…consumption of organic dairy foods	Y_t…GDP	3.37 (0.049)**	6.92 (0.032) **	6.74 (0.034)**
	Y_t…gross disp. Income	7.58 (0.003)***	13.78 (0.001)***	15.16 (0.001)***

Source: Own processing.

significance in 2008 for the parameter β_1. The results are summarized in the following table:

The results in the table show that the null hypothesis of no breakpoint in 2008 for the parameter β_1 was rejected in all regression equations examined at the 5% significance level, using all test criteria considered. The observed instability of the coefficient β_1 will therefore be explicitly modeled using auxiliary binary variables as follows (Eq. 4):

$$\Delta c_t = \beta_0 \cdot B_t \cdot \Delta y_t + \beta_1 \cdot (1 - B_t) \cdot \Delta y_t + \beta_2 \cdot \hat{u}_{t-1} + \varepsilon_t, \quad (4)$$

while the interpretation of the variables is the same as in the relation (3), the binary variable B_t is defined as follows:

$$B_t = \begin{cases} 1, \text{for } t < 2008, \\ 0, \text{for } t \geq 2008. \end{cases}$$

Results of the econometric estimation of the error correction model in the form (4) using the least squares method are summarized in Table 4 for all regression equations examined. In addition to the estimation of the parameters ($\beta_i, i = 0,1,2$), the *p*-value of the t-test of its statistical significance is also reported in parentheses for each estimate in the table. In the last column of the table, the coefficient of determination R^2 of the regression model is presented.

Statistical significance of the parameter β_0 according to the t-test proved to be significant even at the 1% significance level in the three regression equations considered. The null hypothesis $H_0 : \beta_0 = 0$ is therefore rejected in all these cases. Thus, before 2008, the explanatory variable Δy_t had a statistically significant effect on organic food consumption Δc_t . A 1% year-on-year increase in real GDP *per capita* led to a year-on-year increase:

- total real *per capita* consumption of organic food by 0.350 percentage points,
- real *per capita* consumption of organic dairy products by 0.518 percentage points.

By analogy, the 1% year-on-year increase in real gross disposable income *per capita* led to an annual increase:

- total real *per capita* consumption of organic food by 0.362 percentage points,
- real *per capita* consumption of organic dairy products by 0.514 percentage points.

In 2008, however, this statistical dependence of organic food consumption on real GDP disappeared, as demonstrated by the statistical insignificance of the parameter β_1 in all regression equations considered.

Parameter β_2 satisfies the *a priori* condition $\beta_2 \in (-1,0)$ in all regression relationships examined, according to which the consumption of organic food partially returns to its long-run equilibrium value if it deviates from this equilibrium in the previous period. In the case of the regression with total organic food consumption, the statistical significance of this adjustment mechanism toward equilibrium was found to be at the 5% level of statistical significance. The second regression equation with organic dairy consumption was even at the 1% significance level, while the strength of this mechanism proved to be significantly higher in this case. A deviation of total organic food consumption of 1 percentage point above the long-run equilibrium level in the previous period leads to a year-on-year decline in total organic food consumption of the order of 0.11 percentage points. In the case of the use of the explained variable consumption of organic dairy products, this year-on-year decline is in the range of 0.43–0.56 percentage points.

Determination coefficient R^2 in the regression equations came out to be in the range of 0.221–0.360 in all cases examined, which means that the estimated regression model of error correction of the form (4) can explain on the order of 22.1 to 36% of the total variability in the explained variable. This result can be considered satisfactory given that the variables are expressed in differences in this model. Coefficient of determination R^2 in regression Equations (1) describing the long-run equilibrium relationship was significantly better due to this fact (in the order of 0.71–0.92).

The estimated error correction model of form (4) was econometrically verified based on the analysis of the estimated residuals. Random errors were tested for autocorrelation in a correlogram analysis using the Q-statistic. The results are summarized in the following figure (Figure 3).

The figures show that all autocorrelation and partial autocorrelation coefficients are not statistically significantly different from zero, which is also confirmed by the Q-statistic and its *p*-values (denoted as Prob).

TABLE 4 Results of the econometric estimation of the error correction model (4) by the least squares method.

Dependent and explanatory variable used		Parameter estimation (*P*-value of *t*-test)			R^2
		$\hat{\beta}_0$	$\hat{\beta}_1$	$\hat{\beta}_2$	
C_t…total consumption of organic food	Y_t…GDP	0.350 (0.002)***	0.109 (0.369)	−0.117 (0.037)**	0.267
	Y_t…gross disp. Income	0.362 (0.004)***	0.082 (0.498)	−0.107 (0.019)**	0.221
C_t…consumption of organic dairy foods	Y_t…GDP	0.518 (0.003)***	0.067 (0.725)	−0.561 (0.002)***	0.360
	Y_t…gross disp. Income	0.514 (0.012)**	0.132 (0.501)	−0.433 (0.009)***	0.291

Source: Own processing.

The same conclusion about the absence of autocorrelation was also obtained by the Breusch–Godrey LM (Lagrange Multiplier) test of serial correlation (Breusch, 1978; Godfrey, 1978). The results are summarized in the following Table 5.

The results in Table 5 show that the null hypothesis of no autocorrelation was not rejected in all regression equations examined.

Next, White's (1980) test for heteroskedasticity of random errors was performed, and the results are summarized in Table 6.

The null hypothesis of homoskedasticity of random errors was not rejected, and this result is again valid for all regression equations considered.

The main contribution of the article is to fill a gap in the professional literature devoted to the investigation of the influence of income on the consumption of organic food. Macroeconomic analysis of the dependence of organic food consumption on income is practically non-existent in professional literature, and the article targeted this gap.

The attention was focused on the change in the aforementioned dependence after 2008. This change was proven by statistical tests. It was found and confirmed by formal econometric tests that before 2008, there was a statistically significant positive dependence of organic food consumption on income. At the same time, however, the hypothesis that this dependence disappeared after 2008 in connection with the global economic crisis was confirmed. This important information shows that the organic food market has not been too affected by the falling real incomes related to the economic crisis. Organic food, therefore, has an unquestionable place in the Czech market and plays a non-negligible role in the food market.

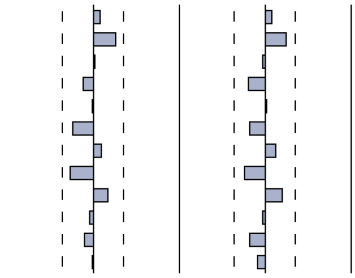
The obtained results turned out to be quite robust, as the mentioned conclusions turned out to be independent of the choice of a specific indicator of aggregate income or a specific indicator of aggregate consumption of organic food. The estimated regression models were also verified using a whole range of statistical and econometric tests—in addition to standard tests on parameters, these include unit root testing, breakpoint testing, and autocorrelation and heteroskedasticity tests. The obtained conclusions are therefore based on a high-quality regression model and rigorous statistical and econometric tests; in addition, the robustness of the obtained results against different specifications was demonstrated.

5 Discussion

The education of the population and systematic cultivation of the consumer role of its members seem to be more and more important parts of the sustainable development of society. One of the crucial issues of sustainable consumption (not only in general but especially in the scope of individual consumption patterns) has been detected in the scope of organic food production and consumption. However, despite the importance of this issue, there is no sufficient scientific attention paid to it. It is connected with two main facts: (1) there is no macroeconomic framework of the consumption detected (excluding the research of Liu et al., 2019 who have finally analyzed interest in organic food globally using data obtained from the Google search engine, and one of their conclusions is that organic food consumption is not correlated with GDP) and (2) when the national specifics of the market on the consumer level are taken into account, the income issue and spending habits are not considered as influenced by psychographic specifics of consumers.

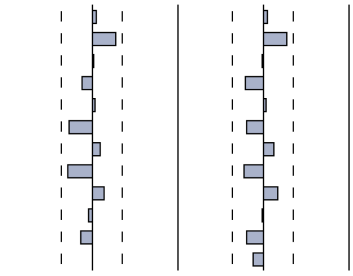
Thus, the huge potential of marketing implications on this specific market disappears, and the effectiveness of marketing activities is not sufficient. This is mainly because income is traditionally perceived as a variable with positive correlation to the spending on organic food—i.e., the higher the income, the higher the consumption, and vice versa (the same is also logically valid for real income, not only its nominal value). This original presumption has been based on the traditional perception of demand and the relation between price and quantity in the scope of the so-called income effect and effect of substitutes. However, in this case, subjectively perceived value sources should be considered. Thus, the scheme of demand does not follow standard rules, and in this case, the purchase of organic food is not affected by real income changes. Similarly, neither its affection by increasing price should be expected. The above-mentioned indicates specifically the high subjectively perceived value of this product category by its consumers. Moreover, others so far realized that research could indicate such a status. Xu et al. (2016) have stated that disposable income is an important factor influencing the willingness to pay a higher price. By applying the logic of an opposite statement, it could be concluded that the lower would be the real income, the lower would be the willingness

A Regression equation with C_t = total consumption of organic food and Y_t = GDP



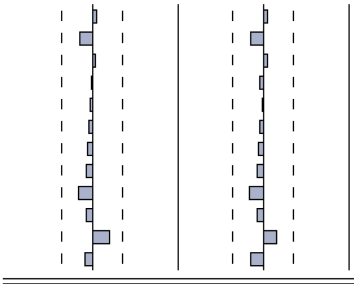
Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.083	0.083	0.2200	0.639
		2	0.271	0.266	2.6716	0.263
		3	0.019	-0.022	2.6836	0.443
		4	-0.112	-0.199	3.1326	0.536
		5	-0.002	0.020	3.1327	0.680
		6	-0.242	-0.173	5.4204	0.491
		7	0.093	0.136	5.7756	0.566
		8	-0.285	-0.241	9.2620	0.321
		9	0.179	0.215	10.703	0.297
		10	-0.038	-0.021	10.771	0.376
		11	-0.102	-0.184	11.289	0.419
		12	-0.007	-0.098	11.291	0.504

B Regression equation with C_t = total consumption of organic food and Y_t = gross disposable income



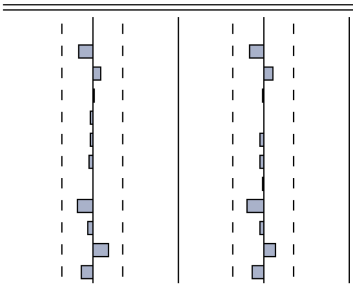
Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.064	0.064	0.1313	0.717
		2	0.293	0.290	2.9866	0.225
		3	0.031	-0.001	3.0197	0.389
		4	-0.108	-0.213	3.4422	0.487
		5	0.037	0.049	3.4944	0.624
		6	-0.272	-0.203	6.3937	0.381
		7	0.101	0.127	6.8093	0.449
		8	-0.292	-0.223	10.463	0.234
		9	0.145	0.184	11.414	0.248
		10	-0.033	-0.006	11.466	0.322
		11	-0.138	-0.199	12.417	0.333
		12	0.004	-0.112	12.418	0.413

C Regression equation with C_t = total consumption of organic dairy products and Y_t = GDP



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.051	0.051	0.0851	0.770
		2	-0.152	-0.155	0.8505	0.654
		3	0.038	0.056	0.8991	0.826
		4	-0.012	-0.042	0.9041	0.924
		5	-0.031	-0.013	0.9392	0.967
		6	-0.033	-0.042	0.9828	0.986
		7	-0.050	-0.051	1.0831	0.993
		8	-0.068	-0.074	1.2817	0.996
		9	-0.157	-0.169	2.3859	0.984
		10	-0.069	-0.077	2.6116	0.989
		11	0.206	0.172	4.7316	0.943
		12	-0.096	-0.148	5.2161	0.950

D Regression equation with C_t = total consumption of organic dairy products and Y_t = gross disposable income



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.015	0.015	0.0070	0.933
		2	-0.166	-0.167	0.9291	0.628
		3	0.104	0.113	1.3063	0.728
		4	0.026	-0.008	1.3305	0.856
		5	-0.026	0.010	1.3556	0.929
		6	-0.030	-0.040	1.3919	0.966
		7	-0.043	-0.047	1.4659	0.983
		8	0.004	-0.003	1.4664	0.993
		9	-0.180	-0.196	2.9172	0.967
		10	-0.061	-0.041	3.0953	0.979
		11	0.199	0.150	5.0643	0.928
		12	-0.124	-0.127	5.8743	0.922

FIGURE 3
Autocorrelation (AC) and partial autocorrelation (PAC) functions of the estimated residuals in the regression models are considered (4). **(A)** regression equation with C_t= total consumption of organic food and Y_t = GDP. **(B)** regression equation with C_t = total consumption of organic food and Y_t = gross disposable income. **(C)** regression equation with C_t = total consumption of organic dairy products and Y_t = GDP. **(D)** regression equation with C_t = total consumption of organic dairy products and Y_t = gross disposable income. Source: Own processing.

TABLE 5 Results of the Breusch–Godfrey LM test for autocorrelation of the error correction model (4).

Dependent and explanatory variable used		Test criterion (*P*-value)	
		F-statistics	$n \cdot R^2$
C_t…total consumption of organic food	Y_t…GDP	1.61 (0.22)	3.41 (0.18)
	Y_t…gross disp. Income	1.85 (0.18)	3.87 (0.14)
C_t…consumption of organic dairy products	Y_t…GDP	0.44 (0.65)	1.00 (0.61)
	Y_t…gross disp. Income	0.44 (0.65)	0.88 (0.64)

Source: Own processing.

TABLE 6 Results of White's test for heteroskedasticity of the error correction model (4).

Dependent and explanatory variable used		Test criterion (P-value)	
		F-statistics	$n \cdot R^2$
C_t…total consumption of organic food	Y_t…GDP	1.46 (0.24)	6.98 (0.22)
	Y_t…gross disp. Income	1.00 (0.44)	5.17 (0.40)
C_t…consumption of organic dairy products	Y_t…GDP	0.28 (0.92)	1.66 (0.89)
	Y_t…gross disp. Income	0.39 (0.85)	2.26 (0.81)

Source: Own processing.

to pay more for organic products in the product category. This argument is also strengthened by the research provided by Yin et al. (2010), who stated that purchases of organic food are significantly influenced by income, trust in organic food, the degree of acceptance of its higher price, and consumers' concern for their health.

If income as a significant macroeconomic factor in the consumption of organic food has been considered previously, the research on the consumption has been managed and realized mainly in terms of national psychographic specifics (Kicova and Nadanyiova, 2015; Krizanova et al., 2015; Jankalova and Vartiak, 2017; Chen et al., 2022). Moreover, Aschemann-Witzel and Zielke (2017) literally stated that income plays only a negligible role compared to psychological factors. In light and shadow of our own research, we could agree with this theory in the wider sense of meaning. However, when stricter criteria of interpretation are applied, we could also state that income and perception are significantly influenced by the individual schemes of values created under specifics of national psychographic profiles. The specific position of the Czech consumer and its psychographic uniqueness, which has made our nationally oriented research reasonable, has been stated by Petljak et al. (2017), who identified the significant factors influencing the willingness of consumers in the Czech Republic and Croatia to pay a higher price for organic food. However, the macroeconomic analysis based on the time series approach is also missing in their research. Thus, our own research has developed their research basis of specifics of organic food consumption and willingness to pay more for this specific product category in terms of the Czech Republic and its market environment.

In our research, we have also followed current scientific trends in this issue—focusing on national and market specifics in terms of product category and country. Other trends, such as organic food products value sources which reflect the price and willingness to pay for them and overall consumer preferences, dedicated to prospective value sources of organic food products have been included in the study indirectly by discussing the psychographic effect of behavioral marketing inclusion when the relationship between organic food consumption and the income of consumption is discussed and interpreted.

Thus, we could conclude that our research significantly enriches the so-far formulated theory as it follows three of four detected scientific trends in this area, and it develops contemporary theory and practice of marketing management of organic food in terms of identifying the very strong phenomenon of subjectively perceived product value which deny the traditional rule of declining demand and provide a valuable platform for further research in this area. Moreover, it has the potential to be helpful in the process of state policy implementation. According to the Czech Ministry of Agriculture, the main issue is (1) to improve the sale of organic food; (2) to make it easier for eco-farms to access the market; (3) to build the domestic market fully competitive with foreign producers; and (4) to increase consumer awareness. However, these are just declaratory statements without any special activities that would support the fulfillment of these goals. Research outcomes are relevant to the last issue focused on consumer awareness. Here, it is just stated in the scope of the policy of the ministry that education should be more oriented on systematic awareness cultivation via specialized programs and public campaigns. As it is obvious from our research, consumption is not sensitive to real income development. It has been proven that the organic food market has not been affected significantly by the falling of real incomes related to the economic crisis. Thus, the importance of education

has been proved. In addition, it has been identified that a significant pillar of organic food consumption, which is relevant for producers—i.e., income does not form a relevant aspect of consumption in this category. Therefore, economic cycles do not have to be followed to ensure sustainability for businesses running in this sector. On the other hand, from a wider perspective, it could be started to discuss organic food as an elementary need in specific consumer segments. The importance is transmitted from the overall income aspect to the knowledge of these segments and their systematic widening.

6 Conclusion

The aim of this study is to analyze the dependence between income and organic food consumption. The dependence has been examined at the macroeconomic level using a time series of aggregate indicators. To describe the statistical dependence, the Error Correction Model (ECM) has been applied. Thus, it has been allowed to examine both the long-run equilibrium relationship between organic food consumption and income and its short-run dynamics. The standard ECM model has been further modified to include a breakpoint analysis with respect to the global economic crisis of 2008. In the context of the statistical breakpoint analysis, a second important objective has been set—to investigate how the dependence of organic food consumption on income changed after 2008 in the context of the global economic recession. To analyze the robustness of the results that were obtained, the total consumption of organic food and the consumption of dairy organic food were analyzed. In addition, to ensure the robustness of the obtained results, both GDP and gross disposable income were used in the analysis.

The obtained conclusions are based on a regression model and rigorous statistical and econometric tests. In addition, the robustness of the obtained results was demonstrated. It has been found and confirmed by formal econometric tests that before 2008, there was a statistically significant positive correlation between organic food consumption and income. At the same time, however, the hypothesis that this correlation would disappear after 2008 as a consequence of the global economic crisis was confirmed. Thus, it has been proven that the organic food market has not been affected significantly by the fall in real incomes related to the economic crisis. Based on these facts, it can be stated that organic food has an unquestionable position in the Czech market and plays a non-negligible role in the food market and its relevant consumption.

These findings are important for theory because they complement previous research and provide different perspective on the consumption of organic food and spending habits of consumers in specific conditions of the Czech Republic. First, they follow the trend of regionally focused research and prove the fact that the consumption of organic food should not be perceived as uniform and that the regional specifics relevant to the national psychographic profile of consumers should be taken into account as they are relevant not only to the subjectively perceived values of the organic food but also to the spending habits of the consumer. Second, they enrich the so-far formulated theoretical patterns of marketing management of organic food and create a platform for further research in this area.

The practical implications consist of the use of research findings in managerial practice. The application of the knowledge that results from one's own research is wide. Mainly, it radically changes the practice of marketing stimulation of the consumer and the planning and prognosis of demand in the scope of wider macroeconomic circumstances. Basically, as it has been proven that consumers are not sensitive to the real income value, they perceive organic food products as stable in the scope of their value perception. In other words, the organic character of products brings sufficient value to consumers, and their consumption does not change even if they face inflation with respect to the decline in their purchasing power. This fact is crucial for the management of such products as the sensitivity on price in case the real value of income would remain could be present as well. If so, there could also be present other phenomena—less need for communication support of the company. In such a case, the cost profile of the company would be significantly optimized.

The crucial limitation in our research is first its territorial validity, i.e., national and cultural specifics of consumers from the Czech Republic. So, the applicability of the research outcomes is justified only in specific conditions of this market. This means that it is not fully possible to apply research outcomes regardless of taking the specifics of the market into account. However, this limitation can be removed by repeating the research in the national conditions of other countries whose national specifics are not convergent to the national specifics of the Czech Republic. The Hofstede's national psycho-graphic profile model could be used for these purposes. However, it should be enriched by analysis of relevant macroeconomic indicators. Based on defined clusters of similar regions (both psychographic and macroeconomic characteristics would be included), the research should be primarily repeated within the same cluster where the Czech Republic is identified. Once the similarity in research outcomes has been detected, the following hypothesis could be formulated: there are inner cluster similarities in organic food consumption from the macroeconomic point of view. When reconsidering this limitation, the results of the research could be considered as relevant, and they could be subject to subsequent verification in the specific national environments. The geographic extension can be perceived as a prospective further direction of the research. Thus, the usability of research outcomes would be wider, and the conclusions could be applied in more complex circumstances of a globalized marketplace.

Similarly, prospective ways of future research extension in this area could be connected with the inclusion of qualitative analysis. Thus, the inclusion of the qualitative research method could partially enrich the process of understanding consumer behavior and the scheme of attitudes toward organic food consumption. In-depth interviewing with respect to the specific incorporation of a questionnaire survey could be applied. However, the strict macroeconomic character of the research should be followed. Otherwise, the research would not fulfill the scientific gap that has been identified in the scope of the macroeconomic aspect of the topic of organic food consumption, and it would just repeat the dominating concept of research—i.e., ″consumer-centric″ from the behavioral point of view.

However, there is still space for further discussions on the implementation of obtained research results on the marketing management patterns of specific grocery categories of organic food. Due to the need to transform consumption to its sustainable form,

this issue has great potential for further research. It would be beneficial to examine and compare the subjective perception of organic food in relation to the spending habits of consumers, for example, in the scope of different generational cohorts of consumers (as it could be understood from one of the detected trends of research in this area—i.e., area of demographic specifics in attitudes toward income spending in favor of organic food products) with respect to the individual categories of organic food (not only on organic milk).

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

JM: Conceptualization, Resources, Supervision, Visualization, Writing – original draft. SC: Data curation, Formal analysis, Investigation, Methodology, Validation, Writing – original draft.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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