DEMAND FUNCTION OF COFFEE

[a]MONIKA BURGHAUSEROVÁ, [b]PAVEL ROUSEK,[C]FILIP PETRÁCH

Institute of Technology and Business in České Budějovice, Okružní 517/10, České Budějovice 37001, Czech Republic email: [a]27011@mail.vstecb.cz, [b]rousek@znalcivste.cz, [c]19651@mail.vstecb.cz

Abstract: The aim of the paper was to investigate the demand function for coffee in selected EU countries using content analysis, price elasticity and income elasticity calculations. The content analysis revealed 13 factors behind the demand for coffee, including quality, rare, healthy, unique and certified coffee, eco-labels, decaffeinated products, sensory and physiological characteristics, human diseases and environmental pollution as the main determinants. The relationship between the demand for coffee and its price was also examined, measuring price and income elasticities of demand. The factors behind coffee demand have created a perfectly inelastic demand in the EU. Low quality coffee is not attractive to consumers who want excellent, rare and healthy products. It is therefore concluded that there is a perfectly inelastic demand for coffee. The quantity demanded is independent of changes in coffee prices, indicating that the quantity demanded does not change despite price fluctuations (no elasticity). Coffee is classified as an inferior commodity in the EU and shows declining demand despite rising incomes.

Keywords: coffee, income elasticity, price elasticity, European Union.

1 Introduction

Coffee is an essential agricultural commodity, kick-starting the economy of many coffee-producing countries (Krishnan et al., 2021). This popular beverage, massively drunk from time immemorial, ranks second among marketable commodities, losing only to oil (Sengupta et al., 2020). Coffee globally grows in importance, as it boosts the economy and gross national product, including developing and less-developed countries (Al-Abdulkader et al., 2018). The increased demand for coffee pulls businessmen and producers when consumers are willing to pay more for a certified product (Wahyudi et al., 2020). The coffee industry is integral to global economies, where developing countries involve 90% of the world's production, supporting about 25 million small farmers (Garcia-Freites et al., 2020). We globally produce over 9.5 billion kg of coffee, and expecting a tripled demand by 2050 (Nab and Maslin. 2020).

Indonesia ranks second behind Brazil, Vietnam and Columbia in global coffee production (Fortunika et al., 2021), generating incomes for local coffee growers, industrial producers, and coffee processing entrepreneurs and encouraging import and export (Prabowo et al., 2021). The coffee supply varies depending on many factors, including coffee quality or production efficiency. Inelastic supply and demand may cause violent fluctuations in the market price (Kuswardhani a Yulian, 2019).Tuyenh et al., 2020 indicate Robusta Coffee as the closest variable influencing the export price of Vietnamese coffee. The estimated variance suggests that a decline in global coffee prices during the financial crisis led to increased school dropout rates of children between 15 and 18 in coffee-producing villages. The effect spreads mainly among this age group (Asfaw, 2018). The essential determinants of coffee production involve nitrogen levels in soil, soil pH, solar radiation, illness and weed rates (Notaro et al., 2022).

Variables related to global macroeconomic and financial development are instrumental in explaining the historical trend in coffee prices and making accurate predictions outside the sample (Crespo Cuaresma et al., 2018). They detected higher prices in organic coffee cherries but, according to Fairtrade, lower average values in other non-certified buyers (Valenciano-Salazar et al., 2022). Chemically-related varieties have similar prices and are more likely to strengthen long-term relationships and adapt to price shocks (Otero et al., 2018). The observed price asymmetry may reflect too much involvement of the coffee supply chain in coffee roasting, where coffee roasting plants receive larger profit shares (Ghoshray and Mohan, 2021). Narcis (2020) suggests an increased likelihood of migration of low-educated people, pointing to marked price inversions. The author blames these outcomes on uninformed producers, well-informed agents and conspicuous consumers in highly unreliable auction markets (Marcus et al., 2022).

Marketing managers promoting fair trade in developing markets should devise effective promotion strategies, using psychological factors to influence consumers to pay for Fair Trade products (Lappeman et al., 2019). Grant and Palakshappa (2018) show how corporate social responsibility affects mainstreaming fair-trade processes, although push-pull strategies change with circumstances and interpretation. Retailers in a local specialized coffee market stimulate creativity, cultural identity and innovation to make their products unique, unwilling to pay a premium for these attributes. Consumers favour a unique café style and product cover (Wann et al., 2018). Systems of sustainability certifications, including FAIRTRADE, FLO, WFTO, and FT-USA, cornered thriving markets (Ribeiro-Duthie et al., 2021). Ardent premium Fair Trade and organic coffee consumers of inelastic demand likely turned to conventional coffee rather than regular Fair Trade and organic coffee. Yet, both alternatives were equally cheap (Lee and Bateman, 2021). We need relevant indicators of coffee sustainability for all players in the value chain. These signals must comply with sustainable development, including transparency and a coherent framework for reporting (Bager and Lambin, 2020).

2 Literary research

Lee and Jeong (2022) suggest a method for predicting coffee grain defects by applying a CNN model to classify binary pictures with 90.44% accuracy. Sunarharum et al. (2018) measured how various post-harvest processing methods affect the physical and sensory quality of Java Arabica green coffee grains. Their findings showed fewer defects in wet-processed coffee than in grains treated in dry conditions. Wang et al. (2021) used the nonlinear grey Bernoulli model based on a parameter-optimization algorithm to make more accurate predictions for demand volatility and uncertainty of coffee grain volumes and prices. They integrated the model with Fourier series of residual modifications to forecast coffee grain prices, exploring the system of the Vietnamese supply chain of coffee grains. The authors used a differential equation of this uncertain system with existing data for the last six years to calculate the coffee grain price.

Atmadji et al. (2018) compared Indonesian and Vietnamese coffee by the demand function, including time series, a cointegration test based on the Bound Tests in the ARDL method. While Malaysians cointegrated their demand for Indonesian coffee, they did not stimulate cointegration regarding Vietnamese products. It means that Vietnamese coffee cannot compare to the Indonesian product in the Malaysian market. Permany et al. (2020) argue that farmers who know about effective marketing channels use the best pathway to get a more reasonable selling price. The authors combined surveys with qualitative and quantitative descriptive analysis. They discovered four marketing Arabica coffee channels, indicating the coffee Arabica Channel I as the geographically most effective label.

Otero et al. (2018) used time series and cross-sectional studies to explore long-term relationships between pairs of coffee prices, assessing chemical, institutional and market factors behind the likelihood of detecting stationary price differences. Using an empirical approach, they found that chemically-related varieties have similar prices, maintain steadier relationships, and better adapt to market shocks. Milijkovic et al. (2019) used the Alchian-Allen theorem to explore a relative demand for three quality-different coffee varieties globally sold, revealing that the Common unit price increases coffee quality. Abaido and Agyapong (2022) measured the impact of price movements of commodities (oil, cocoa, coffee, cotton and gold) in the international market on developing economies in Sub-Saharan Africa. Empirical estimates for theoretical relationships are based on a two-step method of moments, indicating that oil, cocoa and gold per cent inflation in the global market under the same conditions significantly rewards subregions. Strangely enough, the same price changes in cotton and coffee harmed the subregional development.

Fortunika et al. (2021) used a Linear Approximate-Almost Ideal Demand System to analyze the market position of Indonesian coffee and its competitors. They revealed that most slope coefficients were statistically significant and complied with the microeconomic theory, where trade policy variables hugely swayed the Indonesian coffee business. Hakim et al. (2020) tried to increase the added value and profits for small plantations and companies using system dynamics. This methodology involves a modelling technique of system thinking, including feedback loops and time delays, to understand complex dynamics and behaviour of physical, biological and social systems. Scenarios I and II involved changes in model parameters leading to increased business profits in companies, whereas small plantations did not see any growth in earnings. Neto and Robles (2019) used a direct calculation to analyze data on Arabica coffee production. This documentary, descriptive and qualitative research method showed a margin of 61% and an amount produced exceeding the return rates, indicating positive outcomes. This above-average income resulted from the clever use of information from direct costing when managers can optimize the production process, increase the profit margin and ensure business growth and development.

Milani et al. (2020) revealed that some coffee producers add cheap materials (corn, barley or even coffee pods) to commercial coffee to maximize profits. The estimated correlation coefficients involved highly correlated current and future coffee prices. The regression coefficients disclosed a strong relationship between the current and future outputs in all four ICO indicators. The ICE New York (Arabica) and ICE Europe (Robusta) future prices closely relate to current prices. Although the estimated regression coefficients between eventual values and money paid to coffee growers in India indicate a positive relationship, the values scattered around the trend line show a weaker correlation between the money paid to Indian cultivators and the future market price over the monitored period (Babu, 2020). Value generators in the chain comply with production processes aiming to produce excellent coffee grains and provide an exhilarating experience. The study reflects a content analysis of reports gathered from two Brazilian journals over one and a half years (Boaventura et al., 2018).

Durevall (2018) estimated a long-term product share transfer, using regression analysis to explore how the share transfer differs through the market, retailer-owned labels and other product traits in Swedish data on coffee products. He revealed a massive product transfer with large market shares, while transfer rates in goods with modest market shares were low. Vilela and Penedo (2021) applied a multiple linear regression for panel data, using a price paid to the producer for an Arabica coffee bag from 2007 to 2018. The authors used the Kruskal-Wallis test to identify possible relationships between cost variables and the producer's region. The results indicate a negative correlation between the costs of machines, pesticides, production volumes and coffee price fluctuations, whereas taxes demonstrate a positive relationship with coffee price variations. The producer's region significantly correlates with price changes, as productivity, pesticide costs, workforce and machine rates spread among the provinces.

Kittichotsatsawat et al. (2022) explored Arabica coffee yields corresponding to the market demand using artificial neural networks (ANN) and multiple linear regression (MLR). Six-variable data involving regions, production zones, precipitations, relative humidity and minimum and maximum temperature covered 180 months between 2004 and 2018. The authors revealed that the prediction accuracy of R-2 and RMSE from ANN was 0.9524 and 0.0784 t. The ANN model showed potential when measuring yields of Cherry coffee. Handino et al. (2019) mapped the position of small Ethiopian coffee producers who sell the beverage through certified associations. Although the findings indicate better average prices for members of the associations, there is no evidence that higher prices reflect increased household incomes.

The last 20 years have seen a growing demand for coffee (Ruiz et al., 2021), especially for quality and certified coffee varieties (Wahyudi et al., 2020). Global predictions expect an increase in the demand for Arabica and Robusta shortly. Without extra investments in research, we will not be able to meet the rising demand, as climate change gives rise to pests and plant pathogens that hinder productivity (Krishnan et al., 2021). Unusual coffee types (civet coffee) are the most expensive. Its uniqueness and rarity boosted the consumer demand for the product (Raveendran and Murthy, 2022). Gatti et al., 2022 proved that ecolabels could appeal to the tastes of consumers who prefer pesticide-free coffee. Today's global market sees an increased demand for high-quality coffee with marked sensory traits (Seninde et al., 2020), which boosts the marketability and demand for speciality coffee types (Barbosa et al., 2020).

Coffee is one of the most popular global beverages, whose sensory and physiological traits created a high demand for the product in non-traditional markets (Khalif et al., 2022). We currently witness a growing interest in caffeine-free coffee (Seremet et al.,2022). Caffeine is also present in tea. On top of its stimulative effects, the drug's overdose causes various diseases and pollutes the environment, giving way to highly demanded decaffeinated products (Jiang et al., 2019). Consumers have recently increased the demand for quality and healthy drinks, including coffee (Rocchetti et al., 2020). Toraja is a globally renowned coffee grown in Tana Toraja Regency. Despite its limited production, the public demand for the commodity is high (Salam et al., 2021). The growing global interest in unusual coffee varieties calls for standardized and streamlined quality assessment (Giacalone et al., 2019).

Coffee price and quality depend on the type, variety, growing locality, green coffee grain processing and careful production methods (Benes et al., 2020). Consumers want a distinctive coffee aroma, determining the price (Caporaso et al., 2022). The sector producing rare coffee opens opportunities for growers and other partakers, increasing the product's value in the supply chain, driven by inflated consumer purchase prices (Schuit et al., 2021). Curl bugs damage coffee cherries, thwarting coffee yields, quality and production (Hollingsworth et al., 2020). Good roasting, forgery and defective grain detection, unique coffee quality, sensory attributes, chemical composition, coffee varieties and types and geographical origin deeply affect the product's quality and price (Munyendo et al., 2022). Coffee processing methods involve dry, semi-dry and wet techniques, classified by different production processes and product tastes. The varying costs of these processing approaches reflect various coffee grain prices (Karim et al., 2019). In July 2020, the Brazilian state of Minas Gerais, the largest global coffee producer, witnessed severe frost, damaging roughly 30% of local coffee trees. Then, coffee prices soared exorbitantly (Kim and Kim, 2022).

The coffee supply depends on many factors, including low productivity, poor quality, adverse weather and coffee tree diseases. Inelastic supply and demand may cause fluctuations in coffee market prices (Kuswardhani and Yulian, 2019). Sephton 2019 argues El Nino and La Nina have harmed many coffee types, exploring the impacts of climate change on coffee production in Southern Ethiopia. Prolonged dry spells, irregular and insufficient precipitations, temperature increase, or, on the contrary, unexpected heavy rainfalls and snowfalls, pests and diseases, declining soil fertility and weed infestation seriously damage coffee production, quality and costs (Abebe, 2021). Many experts monitored the impact of Covid-19 on the prices of major agricultural commodities, including coffee, using daily data from 1.1.2016 to 25.2.2022. The pandemic slashed the values of farm goods on markets and hugely increased market risk (Balcilar et al., 2022). Coffee production and profitability in Central America face the danger of pest infestation and diseases, price fluctuations and climate change (Lopez-Sampson et al., 2020). Umakanthan and Mathi, 2022 proved that MIRGA technology improved the properties of coffee products and reduced the caffeine content to stimulate healthy consumption and enhance the taste. On top of the health improvement, the technique made the products more affordable.

The article aimed to explore the demand for coffee in the selected EU countries. The demand function involves the relationship between the demanded quantity of coffee and the price. The law of diminishing demand holds that the sought-for amount goes down if the product price rises (excluding changes in prices of other products and incomes). The consumer income is vital since growing retirement benefits will stimulate the demand for coffee and vice versa.

The demanded quantity of coffee depends on the price and label. Some people favour luxury brands, while others prefer cheaper goods.

The coffee price also rests on crops and weather. Poor harvest entails a lack of coffee and its price rise, whereas its prices slump in overabundance.

3 Data a methods

We formulated the following research questions:

RQ1: Which indicators determine the demand for coffee?
RQ2: Which indicators determine the coffee price?
RQ3: What is the relationship between the coffee demand and price?

Research Question 1 involves a content analysis of scientific articles from the Web of Science, using sources containing ‘coffee’ AND ‘demand’ as keywords for the last five years.

Research Question 2 follows the same pattern, including ‘coffee’ AND ‘price’ as access words for the last five years.

The content analysis covers 13 articles for RQ1, measuring the following factors affecting the demand:

- Coffee quality
- Rare and healthy coffee
- Uniqueness and rarity of the coffee
- Certified coffee
- Ecolabels
- Decaffeinated coffee
- Sensory and physiological traits
- Human diseases
- Polluted environment

The demand for quality, rare, healthy and decaffeinated coffee grows as an increased amount of caffeine may be harmful. People seek certified, unique, rare coffee with appealing sensory and physiological traits, preferring eco-friendly and health-protecting labels.

Research question 2 involves 13 sources, including the following factors:

- Weather and climate change
- Pests and plant diseases
- Location of growing
- Low soil fertility and weed infestation
- Types and varieties
- Coffee quality
- Processing and roasting
- Production processes
- Coffee aroma
- Covid-19

Climate change complicates coffee cultivation, resulting in inflated prices, pest blight and diseases afflicting coffee trees. Although worsening soil fertility and weed infestation tremendously increase coffee prices, we still pay more for high-quality, speciality varieties involving costly production.

Research Question 3 tackles the price elasticity of demand, explaining the relationship between the quantity (coffee) demanded and its price. We also explore the elasticity of a pensioner’s demand of income, the proportional changes between the quantity demanded (Q) incomes (I). The formula for the price elasticity is as follows:

$$E_{(p)} = \frac{\triangle Q/Q}{\triangle P/P}$$

Where:

$E_{(p)}$ *is price elasticity of demand,*
$\triangle Q$ *changes in volumes of coffee consumed,*
Q *volume of coffee consumed,*
ΔP *changed coffee prices,*
P *coffee prices.*

The coefficient of the price elasticity will decide whether the demand is elastic or inelastic. We consider the demand elastic if $1 < E(p) < 2$ and the perfectly elastic demand is when $E(p) > 3$. The unit elastic demand is 1. We regard the demand inelastic if $0 < E(p) >1$and the perfectly inelastic demand is when < 0.

The formula for calculating the elastic income demand is as follows:

$$E_{(d)} = \frac{\text{\% change the quantity required}}{\text{\% pension change}}$$

$$\frac{\text{\% required quantity changed}}{\text{\% income changed}}$$

and

$$E_{ID} = \frac{\frac{Q_2 - Q_1}{Q_1 + Q_2}}{\frac{I_2 - I_1}{I_1 + I_2}}$$

here

E_{ID} is elastic income demand.

Luxury goods have the elastic income demand $E_{ID} > 1$, necessary goods $0 < E_{ID} < 1$ and inferior goods $E_{ID} < 0$.

4 Results

RQ1: Which indicators determine the demand for coffee?
We identified factors behind the demand for coffee, including quality, rarity, health, uniqueness, certification, ecolabels, decaffeinated coffee, sensory and physiological traits, human diseases and environmental pollution.

RQ2: Which indicators determine the coffee price?
Factors behind the coffee price involve weather and climate change, pests and plant diseases, geographical location of growing, low soil fertility, weed infestation, types and varieties, quality, processing methods, roasting, production techniques, aroma and Covid-19.

RQ3: What is the relationship between the coffee demand and price?
Table 1 suggests the results of the price elasticity of the demand in selected countries.

Table 1

	Elasticity NV	Elasticity RV	Elasticity NV	Elasticity RV
Austria	0.15	-0.10	Inelastic price of demand	Perfect inelastic demand
Belgium	0.07	0.27	Inelastic price of demand	Inelastic price of demand
Bulgaria	0.35	0.06	Inelastic price of demand	Inelastic price of demand
Cyprus	0.15	-0.25	Inelastic price of demand	Perfect inelastic demand
Czechia	0.20	0.30	Inelastic price of demand	Inelastic price of demand
Denmark	0.05	0.25	Inelastic price of demand	Inelastic price of demand
Finland	-0.40	-0.05	Perfect inelastic demand	Perfect inelastic demand
France	0.40	0.55	Inelastic price of demand	Inelastic price of demand
Germany	0.20	0.15	Inelastic price of demand	Inelastic price of demand
Hungary	0.00	-0.20	Perfect inelastic demand	Perfect inelastic demand
Italy	0.25	-0.15	Inelastic price of demand	Perfect inelastic demand
Latvia	-0.05	0.15	Perfect inelastic demand	Inelastic price of demand
Lithuania	0.00	-0.40	Inelastic price of demand	Perfect inelastic demand
Luxembourg	-0.26	-0.32	Perfect inelastic demand	Perfect inelastic demand
Malta	0.20	0.00	Inelastic price of demand	Perfect inelastic demand
Netherlands	0.55	0.35	Inelastic price of demand	Inelastic price of demand
Poland	0.20	0.00	Inelastic price of demand	Perfect inelastic demand
Portugal	0.15	0.00	Inelastic price of demand	Perfect inelastic demand
Slovakia	-0.15	-0.30	Perfect inelastic demand	Perfect inelastic demand
Slovenia	-0.45	-0.20	Perfect inelastic demand	Perfect inelastic demand
Spain	0.40	0.45	Inelastic price of demand	Inelastic price of demand
Sweden	0.05	0.10	Inelastic price of demand	Inelastic price of demand
EU	-0.70	-0.45	Perfect inelastic demand	Perfect inelastic demand

Table 1 suggests a 'States', 'Nominal Value Elasticity' and 'Real Value Elasticity' columns.

Values higher than 3 suggest a perfect elastic demand, whereas numbers higher than 1 and lower than two indicate an elastic price of demand. A unit elastic demand equals 1, inelastic price of demand is higher than 0 and lower than 1, while a perfect inelastic demand goes below 0.

In Austria, nominal elasticity equals 0.15, which corresponds to price inelastic demand, while real elasticity equals -0.10, perfectly inelastic demand. In Belgium, nominal elasticity values are 0.07 and real elasticity values are 0.27, which in both cases indicate price inelastic demand. The elasticity in nominal value in Bulgaria reaches the result of 0.35 and the elasticity in real value is 0.06. In both cases, this is again a price inelastic demand. The nominal elasticity is as high as 0.15 in Cyprus, indicating that it is a price inelastic demand, while the real elasticity is equal to -0.25, where we find that it is a perfectly inelastic demand. The elasticity in the nominal value in the Czech Republic is 0.20 and the elasticity in the real value is 0.30, so it is a price inelastic demand. In Denmark, we again found price inelastic demand, as the nominal and real values are 0.05 and 0.25, respectively. In Finland, this is a perfectly inelastic value, as the nominal and real elasticities reach negative values. In France, we find that this is a price inelastic demand, as the nominal and real elasticity values are 0.40 and 0.55, respectively. In Germany, nominal elasticity equals 0.20 and real elasticity 0.15, again price inelastic demand. Hungary has achieved perfectly inelastic demand, as the nominal and real elasticities are 0.00 and -0.20, respectively. The nominal elasticity in Italy is 0.25, so it is price inelastic demand, and the real elasticity is -0.15, so it is perfectly inelastic. In Latvia, the level of elasticity in nominal value is -0.05, which corresponds to perfectly inelastic demand, and the level of elasticity in real value is 0.15, so it is price inelastic demand. In Lithuania, the nominal elasticity is equal to 0.00, which means price inelastic demand and the real elasticity is equal to -0.40, so it is a negative value and therefore perfectly inelastic demand. In Luxembourg, the elasticity in nominal and real value reaches -0.26 and -0.32, and therefore it is a perfectly inelastic demand in both cases. The nominal elasticity in Malta is 0.20, indicating price inelastic demand and the real elasticity is 0.00, thus perfectly inelastic demand. The nominal and real elasticities in the Netherlands reached 0.55 and 0.35, respectively, where we found price inelastic demand. In Poland, the nominal elasticity is 0.20, which corresponds to price inelastic demand, and the real elasticity is 0.00, so it is perfectly inelastic demand. In Portugal, the nominal elasticity is as high as 0.15, which is equal to price inelastic demand, and the real elasticity is 0.00, which means that it is perfectly inelastic demand. In Slovakia, the elasticities in nominal and real value are -0.15 and -0.30, here it is evident that this is a perfectly inelastic demand. In Slovenia, nominal and real elasticities reach negative values, which corresponds to perfectly inelastic demand. In Spain and Sweden, it is a price-inelastic demand, both in the case of elasticity in nominal value and elasticity in real value.

Table 1 suggests a perfectly inelastic demand in the EU states, dropping into negative nominal and real values.

Table 2 illustrates the elastic income demand in the selected countries.

Table 2

	Elasticity NV	Elasticity RV	Elasticity NV	Elasticity RV
Austria	-0.25	-0.10	Inferior good	Inferior good
Belgium	0.00	0.20	Normal good	Normal good
Bulgaria	-0.29	-0.24	Inferior good	Inferior good
Cyprus	-0.05	-0.15	Inferior good	Inferior good
Czechia	-0.05	-0.05	Inferior good	Inferior good
Denmark	-0.15	0.05	Inferior good	Normal good
Finland	-0.15	-0.20	Inferior good	Inferior good
France	-0.15	-0.70	Inferior good	Inferior good
Germany	-0.40	-0.55	Inferior good	Inferior good
Hungary	-0.10	-0.15	Inferior good	Inferior good
Italy	0.05	-0.25	Inferior good	Inferior good
Latvia	-0.45	-0.50	Inferior good	Inferior good
Lithuania	-0.15	-0.10	Inferior good	Inferior good
Luxembourg	-0.05	-0.05	Inferior good	Inferior good
Malta	0.30	0.20	Normal good	Normal good
Netherlands	0.10	-0.20	Inferior good	Inferior good
Poland	-0.30	-0.30	Inferior good	Inferior good
Portugal	-0.15	-0.25	Inferior good	Inferior good
Slovakia	-0.30	-0.40	Inferior good	Inferior good
Slovenia	-0.25	0.05	Inferior good	Inferior good
Spain	-0.40	-0.25	Inferior good	Inferior good
Sweden	-0.35	0.00	Inferior good	Normal good
EU	-0.15	-0.10	Inferior good	Inferior good

Table 2 contains columns of 'states, nominal value elasticity and real value elasticity'.

For luxury goods, income elasticity values are greater than 1, for essential goods the value is greater than 0 and at the same time less than 1, and for inferior goods the value is less than 0, i.e. it reaches a negative number.

We found that in Austria, Bulgaria, Cyprus, the Czech Republic, Finland, France, Germany, Hungary, Italy, Latvia, Lithuania, Luxembourg, the Netherlands, Poland, Portugal, Slovakia, Slovenia and Spain, elasticities in nominal and real value reach negative values and therefore it is an inferior asset. In Belgium, the nominal and real elasticities are 0.00 and 0.20, respectively, corresponding to the current good. In Denmark, the amount of elasticity in nominal value is -0.15, which implies that it is an inferior good, while the amount of elasticity in real value corresponds to a normal good. In Malta, it follows from the elasticities in nominal and real value that it is a common good. In Sweden, the elasticity in nominal value is equal to -0.35, so it is an inferior good, and the amount of elasticity in real value is equal to 0.00, which is a normal good. Table 2 suggests that nominal and real values indicate coffee as an inferior good. We also revealed that the EU countries do not consider the commodity a luxury good, as values did not exceed 1.

5 Discussion

RQ1: Which indicators determine the demand for coffee?

The coffee demand indicators in our content analysis involved quality, rarity and health stimulation, uniqueness, certification, eco-labels, decaffeinated products, sensory and physiological traits, human diseases and environmental pollution. Wahyudi et al. (2020) revealed an increased demand for quality and certified coffee, while Raveendran and Murthy (2022) indicated a growing need for rare, especially civet coffee. Gatti et al. (2022) proved rising consumers' interest in eco-labels. Seninde et al. (2020) argue that today's market abounds with a demand for high-quality coffee with significant sensory traits. Barbosa et al. (2020) and Khalif et al. (2022) concluded that good sensory and physiological characteristics match consumer tastes. Seremet et al. (2022) and Jiang et al. (2019) point to an increased demand for decaffeinated coffee and tea. Based on RQ3, we revealed that the demand for coffee in the EU is inelastic, involving the named factors. Low-class coffee discourages consumers, as people prioritize quality. Rare and healthy coffee products witness a growing demand owing to their sensory and physiological features.

RQ2: Which indicators determine the coffee price?

The coffee price indicators in our content analysis involved weather and climate change, pests and plant diseases, growing location, low soil fertility, weed infestation, type and variety, quality, processing methods, roasting, production methods, aroma and Covid-19. Benes et al. (2020) consider type, variety, growing location and processing methods as crucial factors influencing the price, while Caporaso et al. (2022) emphasize the aroma. Hollingsworth et al. (2020) claim that price is highly receptive to pest infestation, especially the curl bug. Munyendo et al. (2022) argue that roasting forgery and defective grain detection, rare coffee quality, sensory attributes, chemical composition, varieties, types and geographical origin are critical determinants of the coffee price. Karim et al. (2019) consider processing techniques highly instrumental in the observed variable, distinguishing dry, semi-dry, and wet methods. Costly approaches lead to higher prices. Kuswardhani et Yulian (2019) include low productivity and quality, adverse weather and coffee-tree diseases and inelastic supply and demand as decisive factors.

RQ3: What is the relationship between the coffee demand and price?

We found a perfectly inelastic coffee demand in the EU, indicating negative real and nominal elasticity. Values above 3 demonstrated a perfectly elastic demand, whereas rates higher than 1 and lower than 2 showed an elastic price demand. A unit elastic demand reached 1, and inelastic price demand exceeded 0 and was lower than 1. A perfect inelastic dropped below 0 – into negative numbers. Although the EU demand for coffee is perfectly inelastic, Belgium, Bulgaria, the Czech Republic, Denmark, France, Germany, Holland, Spain, and Sweden indicated inelastic price demand. Our survey also revealed that coffee is an inferior good, not exceeding 1. Luxury goods surpassed 1, necessary goods were higher than 0 and lower than 1, while inferior goods dropped below 0 – negative numbers. Table 2 suggests that no country considers coffee a luxury good in a nominal or real value. Although the EU states rank the commodity among inferior goods, some countries did the opposite. Belgium and Malta view the asset as a normal good in both values. Vochozka et al. (2022) disclosed that coffee falls into low-quality goods with near-to-perfect inelastic prices.

6 Conclusion

The article explored the demand function for coffee in the selected EU countries, using a content analysis, price elasticity calculation and income elasticity.

The content analysis unveiled 13 factors behind the coffee demand, including the quality, rare, healthy, unique and certified coffee, eco-labels, decaffeinated products, sensory and physiological traits, human diseases and environmental pollution as main determinants. The consumer demand grows with quality, certified, unique and rare products. Many people support pesticide-free production, kindling the interest in eco-labels. Remarkable sensory and physiological features extend the appeal. Caffeine-free products also gained in popularity, as an increased caffeine intake may cause diseases and environmental pollution. The content analysis revealed 13 factors behind coffee prices including weather and climate change, pests, plant diseases, growing location, low soil fertility and weed infestation, type and variety, processing methods and roasting. Adverse weather, i.e. heavy rainfalls, low precipitations, high temperatures, drought, sharp temperature drops, frost and heavy snowfalls, inflate the coffee price. These factors reflect climate change, hampering production and quality. Damaged coffee trees raise global market coffee prices, which fluctuate owing to inelastic supply and demand. Weather changes cause soil infertility, infested with weeds and pests, especially the curl bug. These issues seriously harm production volumes and prices. The Covid-19 pandemic inflated coffee prices, slashing the values of commodities on agricultural markets. We also studied the relationship between the demand for coffee and its price, measuring the price and income elasticity of the demand.

The results indicated elasticity or inelasticity as follows: a value higher than 3 shows a perfectly inelastic demand, while values exceeding 1 and lower than 2 suggest an elastic price demand. A unit elastic demand equals 1, inelastic price demand surpasses 0 and settles below 1, and perfectly inelastic demand drops under 0, i.e. negative numbers. Negative nominal and real elasticity values for the EU ranged between -0.70 and 0.45, indicating a perfectly inelastic demand. Belgium, Bulgaria, the Czech Republic, Denmark, France, Germany, the Netherlands, Spain and Sweden showed an inelastic price demand. Belgium's nominal and real value equalled 0.07 and 0.27 respectively, demonstrating an inelastic price demand. Bulgaria witnessed a nominal and real value at 0.35 and 0.06, while the Czech Republic was 0.20 and 0.30. Denmark topped 0.05 and 0.25, whereas France peaked at 0.40 and 0.55. Germany showed values of 0.20 and 0.15 and the Netherlands 0.55 and 0.35. Spain saw values of 0.40 and 0.45, while Sweden demonstrated 0.05 and 0.10. Austria had a nominal value of 0.15, indicating inelastic price demand, whereas the real value was negative, demonstrating a perfectly inelastic demand. Cyprus indicated a nominal value of 0.15, showing an inelastic price demand, while negative numbers of the real value implied a perfectly inelastic demand. Italy had an inelastic price demand reaching 0.25 in the nominal value and a perfectly inelastic demand, dropping below 0. Latvia witnessed a negative nominal value, indicating a perfectly inelastic demand, yet peaking the real value at 0.15, suggesting an inelastic price demand. Poland and Portugal demonstrated nominal values of 0.25 and 0.15, implying an inelastic price demand and real values of 0.00, showing a perfectly inelastic demand.

Factors behind the demand for coffee created a perfectly inelastic demand in the EU. Poor-quality coffee is not interesting for consumers who want excellent, rare, and healthy products.

We also determined if the commodity involves luxury, necessary or inferior goods, setting values exceeding 1, higher than 0 and lower than 1 and dropping below 0, respectively. Our findings revealed the EU considers coffee an inferior good in both measured values (nominal and real), indicating negative numbers. Table 2 shows that the EU excludes the commodity from luxury goods, showing values below 1. Belgium ranks coffee among normal goods, indicating 0.00 of a nominal value and 0.20 of a real value. Malta involves the commodity in the same rank, showing a nominal and real value of 0.30 and 0.20, respectively. Denmark saw the nominal value peak at -0.15, corresponding to an inferior good, whereas its real value topped 0.05, referring to normal goods. The same scenario unfolds in Sweden, where the nominal value was negative and the real equalled 0.00, demonstrating inferior and normal goods accordingly.

We fulfilled our research aim, revealing perfectly inelastic demand for coffee in the EU. The quantity demanded is independent of the changes in coffee prices, indicating no change in the amount wanted despite fluctuating prices (no elasticity). Coffee in the EU ranks among inferior goods, showing a declining demand despite growing incomes.

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Primary Paper Section: A

Secondary Paper Section: AH