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Market – Legends and Empirical  
Evidence**

# Unicorn, Yeti, Nessie, and Neoclassical Market – Legends and Empirical Evidence

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**Abstract:** The neoclassical market model continues to have a major influence on important economic policy decisions. In this model, the formation of equilibrium prices at the intersection of the aggregated supply and aggregated demand functions plays a central role. We examine whether the formation of equilibrium prices actually occurs. To do so, we analyze 2,217 prices for homogeneous products recorded by students in stores and online between October 2020 and May 2022. In 143 out of 146 cases, no equilibrium price emerges. The percentage price range regularly exceeds 100%. The presumed steering function of an equilibrium price does not materialize. The establishment of market mechanisms for the efficient solution of economic problems must therefore be questioned.

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## 1. Introduction

Some people believe that cheerful unicorns trot through the few remaining remote primeval forests, that an intermediate form of animal and human, namely the Yeti, is at home in the heights of the Himalayas, and that an underwater monster meanders through the waters of Loch Ness in Scotland. There are eyewitness accounts for all these phenomena. To make a long story short: When critically examining all of these indications, one cannot speak of clear empirical evidence. While very few adults believe in the existence of unicorns, snow giants, and sea monsters, the idea of the neoclassical market is widespread in science and practice and finds many supporters and advocates.

Adam Smith (1776) was the first to emphasize the central importance of markets for all processes at the level of the individual economy as well as at the level of the national economy. The Austrian School propagated the market as the central element of liberal economic activity and free society, and as the decisive counter-concept to planned economy and socialism. Ludwig von Mises, Friedrich August von Hayek, Gottfried Harberler, and Oskar Morgenstern can be considered the most ardent advocates of market orientation. The influential textbook by Paul A. Samuelson (1948) contributed quite significantly to the spread of the notion of the neoclassical market. In current textbooks, such as Mankiw and Taylor (2020), it is presented unchanged: As prices rise, the willingness of (actual or potential) suppliers to provide products increases. With rising prices, however, the willingness of (actual or potential) demanders to purchase the corresponding products decreases. This results in an aggregate supply function with a positive slope and an aggregate demand function with a negative slope. The intersection of the supply and demand functions determines the equilibrium price. This equilibrium price leads to market clearing. We refer to this form of market mechanism as the neoclassical market. The neoclassical market mechanism has the merit of automatically leading to efficient outcomes (Mises, 1929 and 1940). Goods necessarily flow to the demanders who most desire or need them. Goods are necessarily provided by the suppliers who can most easily spare or produce them.

The neoclassical market model is based on a variety of assumptions (Pindyck & Rubinfeld, 2017; Varian, 2014; Samuelson & Nordhaus, 2009): 1. The traded goods are homogeneous, 2. There are many suppliers and many demanders, 3. No supplier and no demander exercises market power, 4. Any supplier and any demander can enter or leave the market at any time without costs, 5. All suppliers and all demanders are independent of each other and consider only their own situation when making decisions, i.e., there is no herd behavior and no strategic behavior, 6. There is complete information and thus no asymmetric information distribution, 7. All suppliers and all demanders are rational agents interested solely in maximizing their utility, 8. Property rights are always evident and undisputed, 9. There are no transaction costs, 10. There are no externalities.

However, it is considered a weakness of the neoclassical market model that the assumptions can often not be considered fulfilled in reality. In practical economic life, there is not a single market in which all ten model assumptions can be regarded as fulfilled (see, e.g., Ötsch, 2019; Bridel, 1997; Walker, 1993). In some markets, not even one of the assumptions is fulfilled. However, this alone cannot shake the neoclassical market model because the core statements of the model fit the everyday experience that when supply declines, prices often rise and when demand declines, prices often fall. Even a model whose assumptions do not correspond to reality can lead to useful descriptions of the real world.

However, this does not relieve economics of the duty to empirically verify whether the neoclassical market really exists or whether it is exclusively the product of a fantasy world - similar to the case, presumably, of unicorns, Yeti, or Nessie. This leads us to the core of the problem. The neoclassical market model largely eludes empirical observation. It is plausible to assume that the aggregate supply function shows an increasing and the aggregate demand function a decreasing trend. Empirically, however, neither the one nor the other function can be represented. This will be illustrated by an example:

An innkeeper who runs the only pub in a village wants to find out how his guests would react to any price changes. So, he tries to get a picture of the aggregate demand function of his guests. For this reason, he distributes questionnaires to the guests. There they are to enter how much beer they would drink at which price level. However, his guests smell a rat and behave strategically. If the price level were higher than the current one, the guests say they would no longer come to the pub at all and would rather drink their beer at home. If the price level were lower than the current one, they make exaggerated statements about their planned consumption behavior. The pub owner who relies on this information is in for a surprise. If he actually lowers the price, the additional consumption estimated by the survey will probably largely fail to materialize. A demand function thus eludes empirical observation.

The same applies to aggregated supply functions. For example, the water protection authority may ask the farmers in a region how much targeted floodplain area they would make available in the event of a flood, depending on how high the authority sets the compensation payments. The farmers will promise large amounts of land as compensation increases, but they do so only to drive up compensation for existing floodplains as much as possible. The strategic behavior of the providers makes it impossible to observe the actual supply function empirically.

Since neither the supply function nor the demand function can be observed, the empirical examination of the neoclassical market model has to focus on the equilibrium price. The market model assumes that all transactions of a given good at a given point in time (at least) are settled at one and the same

price, namely the equilibrium price. Numerous studies have therefore collected prices for homogeneous goods from different suppliers within a market that is clearly defined in terms of space and time. This has shown again and again that prices for one and the same good can vary greatly (see Table 1).

**Table 1:** Synoptic literature review

Research paper	Markets covered	Methods	Conclusion
Stigler (1961)	Cars, anthracite coal	Absolute price range, standard deviation	No price equilibrium
Maynes (1976)	Life insurance, drugstore items, consumer electronics, petrol, etc.	Absolute price range	No price equilibrium
Pratt, Wise & Zeckhauser (1979)	39 different product categories, e.g., bicycles, aquariums, air conditioners	Minimum, maximum, mean, standard deviation	No price equilibrium
Dahlby & West (1986)	Car insurance premiums	Percentage price range, variance, coefficient of variation	No price equilibrium
Van Hooymissen (1988)	Refrigerators, light bulbs, books for children, various groceries	Interstore relative price variability (measure of spread based on standard deviation)	No price equilibrium
Borenstein & Rose (1994)	Flight tickets	Gini coefficient, coefficient of variation	No price equilibrium
Brynjolfsson & Smith (2000)	Books, CDs	Absolute price range, percentage price range, standard deviation	No price equilibrium
Kessner & Polborn (2000)	Life insurances	Coefficient of variation	No price equilibrium
Sorensen (2000)	Prescription drugs	Absolute price range, standard deviation, coefficient of variation, estimated margin	No price equilibrium
Brown & Goolsbee (2002)	Life insurances	Standard deviation of residuals from a regression of life insurance prices paid and various explanatory variables	No price equilibrium
Lach (2002)	Refrigerators, chicken, coffee, flour	Mean, coefficient of variation, F-test, standard deviation, time effects	No price equilibrium
Scholten & Smith (2002)	20 different retail products, e.g., groceries, toiletries, batteries, cleaning products, thermometers	Coefficient of variation	No price equilibrium
Aalto-Setälä (2003)	120 different food items	Standard deviation, mean, regression analysis	No price equilibrium
Baye, Morgan & Scholten (2004)	Consumer electronics	Minimum, absolute price range, percentage price range, coefficient of variation	No price equilibrium
Baye, Morgan & Scholten (2006)	Consumer electronics	Absolute price range, percentage price range, coefficient of variation	No price equilibrium
Hong & Shum (2006)	Books	Absolute price range	No price equilibrium
Lewis (2008)	Petrol	Standard deviation, regression analysis	No price equilibrium
Wildenbeest (2009)	14,000 products from supermarkets	Regression analysis	No price equilibrium
Vukina & Zheng (2010)	Live hogs	Minimum, maximum, mean, standard deviation, absolute price range	No price equilibrium
Moen, Wulfsberg & Aas (2020)	766 homogeneous products in 4,297 retail stores	Coefficient of variation	No price equilibrium

Empirical research on the equilibrium price begins in the second half of the 20th century, when several authors start collecting prices for homogeneous goods in shops or in magazines. Stigler (1961) discovers price dispersion in the automobile and anthracite coal markets. Maynes (1976) compares prices for identical life insurances, medicines, and nine other products and finds that different providers charge very different prices for homogeneous goods. In their influential study, Pratt, Wise & Zeck-

hauser (1979) extend the research to 39 different products. They show that the formation of equilibrium prices suggested by the neo-classical theory is by no means observable in practice. Burdett & Judd (1983) counter that the empirical study of prices is not suitable for deriving convincing statements about the validity of the neoclassical market model. If the observed price dispersion can be explained by search costs, one can still speak of market equilibrium even with different prices for homogeneous goods. However, search costs cannot be quantified easily in practice, which creates a similar dilemma as with the supply and demand functions mentioned at the beginning.

From the 1980s onward, the background to the observed price deviations is increasingly investigated. In particular, factors influencing the extent of price dispersion have come into focus. It has been shown that price dispersion tends to increase when the number of suppliers is low (Baye, Morgan & Scholten, 2004; Dahlby & West, 1986) and in times of strong inflation (Van Hoomissen, 1988). Other studies find that price dispersion tends to be lower for consumer goods that are regularly repurchased (Sorensen, 2000) and for goods in mature markets (Baye, Morgan & Scholten, 2006). Moreover, deviations from the equilibrium price model are also observed within one supplier. Even for the same supplier, there can be strong price deviations for different customer groups (Borenstein & Rose, 1994) or at different times of the day (Vukina & Zheng, 2010), which also does not fit the neoclassical theory.

Technological and political events also influence the scientific debate about the equilibrium price. In the 1990s, increasing globalization and the spread of the Internet are changing the way commerce works. The transportation of raw materials and finished goods is constantly becoming faster and cheaper. New forms of communication make it possible to work efficiently with supra-regional customers and suppliers at different points in the value chain, which creates more competition. Due to all these influencing factors, the number of potential suppliers and buyers within a market increases massively. The increasing spread of the Internet also ensures more transparency for customers, who can now compare prices from different providers much more easily.

These changes lead to a revival of empirical research on equilibrium pricing in the early 2000s. However, the studies always come to the same conclusion. Globalization and the introduction of the Internet have slightly shifted the extent of price dispersion in individual market segments, but an equilibrium price in the sense of neoclassical theory is still nowhere to be observed (Brown & Goolsbee, 2002; Scholten & Smith, 2002; Brynjolfsson & Smith, 2000).

Since the 2010s, fewer and fewer price comparisons have been published to test the neoclassical market model. The new studies partly argue on the basis of data that are several decades old (e.g., Moen, Wulfsberg & Aas, 2020). With the beginning of the 2020s, however, massive political and societal cuts have again had an impact on markets. In the course of the Covid19 pandemic, international supply

chains collapsed en masse. Important products for daily use became scarce within a short period of time. Many consumers also faced changing financial conditions due to layoffs and short-time work. All of this can lead to changes in behavior on the part of both suppliers and consumers.

We see it as an important task of research to continuously test the validity of established models from theory in practice. The neoclassical market model is undoubtedly one of them. This study therefore raises the research question of whether an equilibrium price has been established for different product categories and products in the year of the Covid19 pandemic outbreak (2020) and the two subsequent years.

## 2. Data basis

To shed more light on our research question, we evaluate actual prices for homogeneous goods announced by retailers between October 2020 and May 2022. The prices were collected and documented by students of the Ostfalia University of Applied Sciences Wolfsburg in brick-and-mortar stores or online. In-store price collections were conducted in northern Germany in twelve cities (Braunschweig, Einbeck, Gifhorn, Goslar, Hannover, Helmstedt, Hildesheim, Lüneburg, Peine, Salzgitter, Wolfenbüttel, and Wolfsburg). Online price collections were conducted on price comparison portals or directly on the retailers' websites. All prices were quoted in €. All price observations were documented by photos or screenshots with location and time information. The observations have been published in the series "Wolfsburg Invisible Hand Studies" (WIHSt).

The eleven studies in the WIHSt series (see Table 2) cover 146 price comparisons for 77 different products, consisting of a total of 2,217 individual price observations (see Table 3). Each price comparison thus comprises an average of 15.185 prices from different retailers for one and the same product.

**Table 2:** Overview of studies from the "Wolfsburg Invisible Hand Studies" series

Study	Year	Authors
WIHSt 1	2021	Kornhardt, C.
WIHSt 2	2021	Yavuz, D.
WIHSt 3	2021	Clar, F., Petrunina, J., Qitaku, A. & Zubke, L.
WIHSt 4	2021	Chmielewski, L. & Kunzmann, O.
WIHSt 5	2021	Möbius, D., Schmidt, M. & Waldhelm, S.
WIHSt 6	2021	Flemming, J., Boztepe, C. & Tawbe, S.
WIHSt 7	2022	Wenzlaff, L. & Leohold, S.
WIHSt 8	2022	Beck, O. & Ülker, S.-L.
WIHSt 9	2022	Wahlers, J. & Schulenburg, S. von der
WIHSt 10	2022	Younis, R. & Sokolowski, P.
WIHSt 11	2022	Ziegner, K. & Mützel, P.

**Table 3:** Number of price observations per product category

<b>Product category</b>	<b>Price comparisons</b>	<b>Prices</b>
Drugstore	47	634
Food	59	776
Other	40	807
<b>Total</b>	<b>146</b>	<b>2,217</b>

*For a detailed overview per product, see Table A-1 in the appendix.*

The database is divided into 47 price comparisons for drugstore products (634 price observations), 59 price comparisons for food (776 price observations), and 40 price comparisons for other products (807 price observations). The "Other" category includes products from the areas of consumer electronics, toys, kitchen appliances, clothing, printer supplies, medicines, car accessories and sports & outdoor. The original product designations are used below. An overview of the respective English product descriptions can be found in Table A-2 in the appendix.

Eight products are examined in more than one Wolfsburg Invisible Hand Studies (WIHSt). These are Red Bull Classic 250ml (3x), as well as Funny-frisch „Ungarisch" 175g, Nutella Nuss-Nugat-Creme 450g, Pringles „Original" 200g, Duschdas Duschgel Sport 2-in-1 250ml, Milka Alpenmilch 100g, WMF Kult X Mix & Go 0,6l, and Dr. Oetker Ristorante Pizza Salame 320g (2 each). For the remaining 69 products, prices are only examined in one WIHSt each.

The price comparisons in the studies from the WIHSt series are from 2020 (10x), 2021 (84x), and 2022 (52x). 45 price comparisons were conducted exclusively in brick-and-mortar stores, 52 price comparisons were conducted exclusively online, and 49 price comparisons were conducted both in brick-and-mortar stores and online. In the 101 price comparisons that were conducted completely or partially online, prices including shipping costs were documented in 35 cases.

### **3. Methods**

The prices are examined with regard to the setting of an equilibrium price. An equilibrium price exists when all transactions are carried out at the same price. To this end, the lowest observed price (minimum) is compared with the highest observed price (maximum). The difference between minimum and maximum is the absolute price range. If it is different from 0, there is no equilibrium price.

In order to determine the extent of price dispersion, relative measures of dispersion are used in the form of the percentage price range and the coefficient of variation. The percentage price range is obtained by dividing the absolute price range by the minimum:

$$\text{Percentage Price Range } (X) = \frac{\text{Absolute Price Range } (X)}{\text{Minimum } (X)} \times 100\% = \frac{[\text{Max } (X) - \text{Min } (X)]}{\text{Min } (X)} \times 100\%$$

A percentage price range > 100% indicates that the absolute price range is larger than the minimum. In other words, in this case the maximum is more than twice as large as the minimum, which indicates a strong deviation from an equilibrium price.

The coefficient of variation is obtained by dividing the standard deviation by the arithmetic mean of the observations:

$$\text{Coefficient of Variation } (X) = \frac{\text{Standard Deviation } (X)}{\text{Arithmetic Mean } (X)} = \frac{\sigma (X)}{\mu (X)}$$

A coefficient of variation > 0.1 indicates that the standard deviation is greater than 10% of the arithmetic mean, which also indicates a strong deviation from an equilibrium price.

The percentage price range and the coefficient of variation are more meaningful in that they relate the absolute price range and the standard deviation, respectively, to the price of the product. An absolute price range or a standard deviation of €1 represents a significantly more serious deviation from an equilibrium price if the observed product is priced in the order of €10 than if it is priced in the order of €1,000.

#### 4. Results

A total of 146 price comparisons are analyzed. In 143 cases, the absolute price range, percentage price range, standard deviation, and coefficient of variation are not equal to zero. That is, in 143 of 146 cases, different prices were observed for a homogeneous good at a given time within a narrowly defined geographic area. The average percentage price range is 126.37%. The one-sample t-test supports that there is no equilibrium price (p-value = 0.000).

First, the price comparisons collected purely in brick-and-mortar retail stores are considered (Table 4). Here, 45 price comparisons with 398 individual price observations are carried out. The products for which a price comparison is carried out are displayed sorted according to the coefficient of variation (last column). That is, from products that show a large deviation from an equilibrium price to products that show a less large deviation from an equilibrium price.

**Table 4:** Comparison of prices collected in stores

Product	#	Min	Max	$\bar{x}$	$\sigma$	Absolute price range	Percentage price range	CV
Coca-Cola Original Taste 0,33l	17	€0.59	€2.29	€0.95	€0.47	€1.70	288.14%	0.495
Nivea Deoroller Fresh pure 0%	11	€1.65	€1.95	€1.92	€0.90	€0.30	18.18%	0.469
Milka Alpenmilch 100g	10	€0.59	€1.99	€1.03	€0.43	€1.40	237.29%	0.418
Pringles Chips Sour Cream & Onion 200g	13	€1.29	€3.89	€2.14	€0.78	€2.60	201.55%	0.364
Funny-frisch „Ungarisch“ 175g	12	€1.49	€3.29	€1.71	€0.50	€1.80	120.81%	0.294
Snickers 50g (07.08.21)	8	€0.69	€1.39	€0.86	€0.25	€0.70	101.45%	0.291
Snickers 50g (30.08.21)	8	€0.69	€1.39	€0.86	€0.25	€0.70	101.45%	0.291
Pflaster Hansaplast "Classic"	20	€2.95	€5.55	€3.75	€1.06	€2.60	88.14%	0.282
Konfitüre Schwartau Extra Erdbeere 340g	7	€1.39	€3.49	€2.32	€0.62	€2.10	151.08%	0.266
Red Bull Classic 250ml	16	€1.05	€2.55	€1.55	€0.40	€1.50	142.86%	0.258
Honig Langnese "Flotte Biene" 250g	5	€2.99	€4.49	€3.29	€0.67	€1.50	50.17%	0.204
Jägermeister 0,7l	9	€10.49	€18.99	€12.77	€2.43	€8.50	81.03%	0.190
UHU Kleber 21g (09.08.21)	7	€1.89	€2.99	€2.15	€0.39	€1.10	58.20%	0.181
UHU Kleber 21g (30.08.21)	6	€1.89	€2.99	€2.18	€0.39	€1.10	58.20%	0.179
Dr. Oetker Ristorante Pizza Salame 320g	8	€1.59	€2.49	€2.28	€0.39	€0.90	56.60%	0.171
Red Bull Sugarfree 250ml	19	€0.87	€1.59	€1.18	€0.20	€0.72	82.76%	0.170
Nutella Nuss-Nugat-Creme 450g	7	€2.99	€4.29	€3.18	€0.49	€1.30	43.48%	0.154
Zahnpasta Elmex "Kariesschutz"	24	€2.55	€4.20	€3.19	€0.47	€1.65	64.71%	0.146
Pril Kraftgel Ultra Plus	19	€0.99	€1.45	€1.33	€0.19	€0.46	46.46%	0.143
Pringles „Original“ 200g	9	€2.59	€3.69	€2.71	€0.37	€1.10	42.47%	0.137
Duschgel Kneipp "Lebensfreude"	12	€2.95	€4.45	€3.11	€0.42	€1.50	50.85%	0.136
Niemand Dry Gin 0,5l (30.08.21)	3	€28.99	€36.99	€34.31	€4.61	€8.00	27.60%	0.134
UNO Standard	9	€6.99	€9.99	€8.77	€1.11	€3.00	42.92%	0.127
Converse Chuck Taylor All Star High	7	€49.99	€75.00	€71.41	€8.75	€25.01	50.03%	0.123
Géramont „Classic“ 200g	6	€1.66	€2.44	€2.29	€0.28	€0.78	46.99%	0.122
Niemand Dry Gin 0,5l (06.08.21)	4	€28.99	€36.99	€34.98	€3.99	€8.00	27.60%	0.114
Maggi Würze 250g	20	€1.25	€2.39	€1.80	€0.19	€1.14	91.20%	0.103
Nivea Soft 200ml	13	€2.85	€3.49	€2.96	€0.22	€0.64	22.46%	0.074
WMF Kult X Mix & Go 0,6l	3	€29.99	€34.99	€33.31	€2.35	€5.00	16.67%	0.071
Xiaomi Scooter 1S	3	€395.99	€449.00	€413.66	€24.99	€53.01	13.39%	0.060
Leibniz Keks'N Crem Choco 228g	9	€1.69	€1.99	€1.85	€0.11	€0.30	17.75%	0.058
AirPods 2. Gen. / MV7N2ZM/A (30.08.21)	4	€132.99	€149.00	€134.32	€7.58	€16.01	12.04%	0.056
TomTom "Go Discover 7"	3	€269.00	€299.00	€281.33	€12.82	€30.00	11.15%	0.046
AirPods 2. Gen. / MV7N2ZM/A (18.08.21)	4	€126.95	€136.99	€129.97	€4.78	€10.04	7.91%	0.037
Schauma 7 Kräuter Shampoo	17	€1.65	€1.99	€1.94	€0.07	€0.34	20.61%	0.036
HP 302 Cyan/Magenta/Gelb Druckerpatrone	5	€22.90	€24.99	€23.37	€0.81	€2.09	9.13%	0.035
Hipp "Ultra Sensitiv" Feuchttücher 4er Pack	4	€3.45	€3.79	€3.62	€0.12	€0.34	9.86%	0.034
Hipp "Zart Pflegend" Feuchttücher 4er Pack	4	€3.45	€3.65	€3.54	€0.09	€0.20	5.80%	0.025
Barilla Penne Rigate 500g	6	€1.65	€1.69	€1.68	€0.02	€0.04	2.42%	0.012
I Love Extreme Mascara "Volume"	3	€2.75	€2.79	€2.76	€0.02	€0.04	1.45%	0.007
Pampers "Premium Protection" 26 Stück	6	€3.95	€3.99	€3.96	€0.02	€0.04	1.01%	0.005
Aptamil "Pronatura PRE" 800g	5	€15.95	€15.99	€15.97	€0.02	€0.04	0.25%	0.001
Duschdas Duschgel Sport 2-in-1 250ml	6	€1.25	€1.25	€1.25	€0.00	€0.00	0.00%	0.000
Pampers "Baby Dry" 21 Stück	3	€2.95	€2.95	€2.95	€0.00	€0.00	0.00%	0.000
Bebe "Creme Intensivpflege" 50ml	4	€3.45	€3.45	€3.45	€0.00	€0.00	0.00%	0.000
<b>Total</b>	<b>398</b>							<b>0.145</b>

# = Number of observations; Min = Minimum; Max = Maximum;  $\bar{x}$  = Arithmetic mean;  $\sigma$  = Standard deviation; CV = Coefficient of variation.

For the product "Coca-Cola Original Taste 0,33l", 17 individual price observations are collected from 17 different retailers. While the observed minimum sales price is €0.59, the observed maximum price for this product is €2.29. The mean of the price observations is €0.95, and the standard deviation is

€0.47. The absolute price range of €1.70 is obtained by subtracting the minimum from the maximum. The percentage price range is 288.14%, showing that the absolute price range is almost three times as high as the minimum price. The coefficient of variation of 0.495 also shows that there is a strong deviation from an equilibrium price.

It is remarkable that for the three goods in the last three rows of Table 4, for which all observed prices are identical (coefficient of variation = 0.000), only very few prices are recorded ( $n = 3$ ;  $n = 4$ ;  $n = 6$ ). One of these products is "Duschdas Duschgel Sport 2-in-1, 250ml" in WIHSt 5. The same product is also observed in WIHSt 3, but there at 29 different retailers. WIHSt 3 determines an absolute price range of €0.50 for this product and therefore no equilibrium price.

Overall, the prices collected in brick-and-mortar stores yield an average coefficient of variation of 0.145. The majority of price comparisons in brick-and-mortar stores show that an equilibrium price cannot be observed.

Table 5 lists the price comparisons carried out purely in online retailing. Shipping costs are not taken into account at first. Here, 28 price comparisons with 497 individual price observations are carried out. For the product "Bebe Creme Intensivpflege 50ml", the mean of €4.67 and the standard deviation of €2.26 result in the highest coefficient of variation of 0.485 and thus the greatest deviation from an equilibrium price.

The largest percentage price range is observed for the product "UHU Kleber 21g" at 602.78%. That is, the most expensive retailer offers the product at a selling price more than six times higher than the least expensive retailer. Overall, the high percentage price ranges in online retailing show that there are large price differences among suppliers on the Internet. This is also reflected in the higher average coefficient of variation of 0.219 in online retailing compared with stationary retailing. In the price comparisons carried out among online retailers without taking shipping costs into account, an equilibrium price cannot be observed.

**Table 5:** Comparison of prices collected online excluding shipping costs

Product	#	Min	Max	$\bar{x}$	$\sigma$	Absolute price range	Percentage price range	CV
Bebe "Creme Intensivpflege" 50ml	6	€3.44	€9.70	€4.67	€2.26	€6.26	181.98%	0.485
Nivea Soft 200ml	8	€2.66	€8.02	€3.82	€1.81	€5.36	201.50%	0.474
UHU Kleber 21g (09.08.21)	43	€1.08	€7.59	€2.35	€1.11	€6.51	602.78%	0.472
UHU Kleber 21g (30.08.21)	51	€1.08	€7.59	€2.34	€1.07	€6.51	602.78%	0.457
Zahnpasta Elmex "Kariesschutz"	9	€2.89	€7.70	€3.82	€1.58	€4.81	166.44%	0.414
WMF Kult X Mix & Go 0,6l	6	€29.99	€64.99	€40.16	€13.86	€35.00	116.71%	0.345
Duschgel Kneipp "Lebensfreude"	10	€2.39	€5.99	€3.31	€1.06	€3.60	150.63%	0.321
Nivea Deoroller Fresh pure 0%	7	€1.65	€3.73	€2.32	€0.74	€2.08	126.06%	0.319
Red Bull Classic 250ml	4	€1.20	€2.44	€1.70	€0.46	€1.24	103.33%	0.271
Pampers "Premium Protection" 26 Stück	9	€3.82	€8.18	€5.45	€1.45	€4.36	114.14%	0.267
WMF Kult X Mix & Go 0,6l	16	€29.99	€59.99	€37.04	€9.35	€30.00	100.03%	0.252
Honig Langnese "Flotte Biene" 250g	7	€2.72	€5.10	€3.76	€0.85	€2.38	87.50%	0.226
AirPods 2. Gen. / MV7N2ZM/A (18.08.21)	76	€123.80	€345.69	€150.94	€30.97	€221.89	179.23%	0.205
Pflaster Hansaplast "Classic"	12	€2.80	€4.79	€3.58	€0.60	€1.99	71.07%	0.169
UNO Standard	11	€6.52	€10.71	€8.21	€1.37	€4.19	64.26%	0.167
Konfitüre Schwartau Extra Erdbeere 340g	7	€2.09	€3.29	€2.63	€0.44	€1.20	57.42%	0.166
AirPods 2. Gen. / MV7N2ZM/A (30.08.21)	89	€119.95	€236.29	€150.63	€23.29	€116.34	96.99%	0.155
Nutella Nuss-Nugat-Creme 450g	7	€2.84	€4.15	€3.39	€0.50	€1.31	46.13%	0.148
HP 302 Cyan/Magenta/Gelb Druckerpatrone	15	€17.64	€27.99	€22.48	€3.06	€10.35	58.67%	0.136
Niemand Dry Gin 0,5l (30.08.21)	24	€26.01	€39.90	€32.33	€3.57	€13.89	53.40%	0.110
Niemand Dry Gin 0,5l (06.08.21)	23	€26.01	€39.90	€32.54	€3.59	€13.89	53.40%	0.110
Converse Chuck Taylor All Star High	11	€55.95	€79.00	€72.10	€6.06	€23.05	41.20%	0.084
TomTom "Go Discover 7"	11	€214.46	€299.99	€271.66	€22.29	€85.53	39.88%	0.082
Algemarina Trockenshampoo 200ml	5	€2.95	€3.49	€3.27	€0.26	€0.54	18.31%	0.081
Head&Shoulders Apple Fresh 300ml	13	€3.29	€3.99	€3.90	€0.26	€0.70	21.28%	0.067
Sony Playstation 5 Disc Version	5	€795.99	€944.00	€887.72	€48.94	€148.01	18.59%	0.055
Xiaomi Scooter 1S	6	€395.00	€499.00	€415.58	€18.56	€104.00	26.33%	0.045
I Love Extreme Mascara "Volume"	6	€2.75	€3.09	€2.83	€0.12	€0.34	12.36%	0.042
<b>Total</b>	<b>497</b>							<b>0.219</b>

# = Number of observations; Min = Minimum; Max = Maximum;  $\bar{x}$  = Arithmetic mean;  $\sigma$  = Standard deviation; CV = Coefficient of variation.

A similar picture emerges when looking at price comparisons for online retailing including shipping costs (Table 6). Here 24 price comparisons with 459 individual price observations are considered. If shipping costs are incurred, the inclusion of the shipping costs in the sales prices may increase the maximum price by the amount of the shipping costs. If no shipping costs are incurred or if these are included in the product price, the sales price does not increase, and the minimum price may remain constant. This can affect the average price, the standard deviation, the absolute and percentage price range, and the coefficient of variation.

Both the highest coefficient of variation (0.515) and the highest percentage price range (685.83%) are found for the product "Red Bull Classic 250ml". Overall, across the 24 price comparisons, the average coefficient of variation for online retailing including shipping costs is 0.200. This is slightly lower than the coefficient of variation for online retailing excluding shipping costs. Likewise, an equilibrium price cannot be observed for online retailers including shipping costs in any price comparison.

**Table 6:** Comparison of prices collected online including shipping costs

Product	#	Min	Max	$\bar{x}$	$\sigma$	Absolute price range	Percentage price range	CV
Red Bull Classic 250ml	4	€1.20	€9.43	€5.92	€3.05	€8.23	685.83%	0.515
Nivea Deoroller Fresh pure 0%	7	€1.65	€9.14	€5.51	€2.18	€7.49	453.94%	0.396
WMF Kult X Mix & Go 0,6l	6	€29.99	€68.94	€42.96	€15.08	€38.95	129.88%	0.351
Duschgel Kneipp "Lebensfreude"	10	€2.39	€11.98	€7.08	€2.37	€9.59	401.26%	0.335
Konfitüre Schwartz Extra Erdbeere 340g	7	€2.09	€9.28	€7.18	€2.39	€7.19	344.02%	0.333
WMF Kult X Mix & Go 0,6l	16	€29.99	€63.94	€40.81	€9.60	€33.95	113.20%	0.235
Nivea Soft 200ml	8	€6.16	€10.92	€8.13	€1.73	€4.76	77.27%	0.213
Honig Langnese "Flotte Biene" 250g	7	€6.96	€12.09	€8.79	€1.81	€5.13	73.71%	0.206
AirPods 2. Gen. / MV7N2ZM/A (18.08.21)	76	€124.55	€345.69	€153.67	€30.53	€221.14	177.55%	0.199
Pflaster Hansaplast "Classic"	12	€2.95	€7.94	€6.92	€1.36	€4.99	169.15%	0.196
Nutella Nuss-Nugat-Creme 450g	7	€5.98	€9.95	€8.27	€1.40	€3.97	66.39%	0.170
Pampers "Premium Protection" 26 Stück	9	€6.81	€12.96	€9.94	€1.65	€6.15	90.31%	0.166
UHU Kleber 21g (09.08.21)	43	€3.39	€9.86	€7.56	€1.21	€6.47	190.86%	0.160
UHU Kleber 21g (30.08.21)	51	€3.39	€10.45	€7.61	€1.17	€7.06	208.26%	0.154
AirPods 2. Gen. / MV7N2ZM/A (30.08.21)	89	€119.95	€236.29	€153.42	€22.95	€116.34	96.99%	0.150
Zahnpasta Elmex "Karienschutz"	9	€5.88	€8.70	€7.09	€1.01	€2.82	47.96%	0.143
UNO Standard	11	€6.99	€13.68	€11.00	€1.54	€6.69	95.71%	0.140
I Love Extreme Mascara "Volume"	6	€6.25	€8.69	€7.04	€0.90	€2.44	39.04%	0.129
Bebe "Creme Intensivpflege" 50ml	4	€7.13	€9.70	€8.04	€1.00	€2.57	36.04%	0.124
HP 302 Cyan/Magenta/Gelb Druckerpatrone	15	€20.63	€30.87	€25.67	€2.99	€10.24	49.64%	0.117
Niemand Dry Gin 0,5l (30.08.21)	24	€31.24	€45.80	€37.79	€3.98	€14.56	46.61%	0.105
Niemand Dry Gin 0,5l (06.08.21)	23	€31.05	€43.98	€38.01	€3.67	€12.93	41.64%	0.097
Converse Chuck Taylor All Star High	11	€58.85	€82.94	€73.89	€6.36	€24.09	40.93%	0.086
Algemarina Trockenshampoo 200ml	4	€6.48	€7.99	€7.20	€0.57	€1.51	23.30%	0.079
<b>Total</b>	<b>459</b>							<b>0.200</b>

# = Number of observations; Min = Minimum; Max = Maximum;  $\bar{x}$  = Arithmetic mean;  $\sigma$  = Standard deviation; CV = Coefficient of variation.

The ability to ship products enables an online retailer to operate in the same geographical area as a brick-and-mortar retailer. In this way, the number of retailers offering a product in a narrowly defined geographic area can increase significantly. Therefore, it is also necessary to consider online retail and brick-and-mortar retail together. In Table 7, the aggregated results of stationary and online trade are presented excluding shipping costs. Here, 38 price comparisons with 692 individual price observations are considered.

The highest coefficient of variation is 0.478, observed for the product "Milka Haselnusschokolade 100g". The cheapest retailer offers the product for €0.57 and the most expensive retailer for €1.89. This results in an absolute price range of €1.32, which is more than double the price of the cheapest vendor. This is also shown by the percentage price range of 231.58%.

For the joint consideration of stationary trade and online trade across all 38 price comparisons, the average coefficient of variation is 0.203. The inclusion of online retailers in addition to stationary retailers thus leads to an overall increase in the coefficient of variation. The extent of price dispersion is similar to that of pure online retailing. An equilibrium price cannot be determined here either.

**Table 7:** Comparison of prices collected in stores and online excluding shipping costs

Product	#	Min	Max	$\bar{x}$	$\sigma$	Absolute price range	Percentage price range	CV
Milka „Haselnusschokolade“ 100g	6	€0.57	€1.89	€1.11	€0.53	€1.32	231.58%	0.478
Red Bull Classic 250ml	14	€0.85	€2.79	€1.52	€0.68	€1.94	228.24%	0.447
Funny-frisch „Ungarisch“ 175g	12	€1.34	€3.59	€1.68	€0.66	€2.25	167.91%	0.393
Red Bull Classic 250ml <sup>1</sup>	15	€0.88	€2.75	€1.40	€0.54	€1.87	212.50%	0.384
Extra Professional White Kaugummi 50 Stück	12	€2.25	€4.50	€3.02	€1.03	€2.25	100.00%	0.341
Nivea Dry Impact Deo 150ml	7	€1.75	€3.53	€2.07	€0.65	€1.78	101.71%	0.314
Pringles „Original“ 200g	12	€1.15	€4.00	€2.51	€0.74	€2.85	247.83%	0.295
Haribo Happy Cola 200g	10	€0.69	€1.79	€1.19	€0.35	€1.10	159.42%	0.291
Odol-med3 Zahnpasta Extra White 125ml	20	€0.99	€2.99	€1.54	€0.43	€2.00	202.02%	0.279
Heineken Pils 6 x 0,33l	10	€4.85	€10.26	€6.00	€1.67	€5.41	111.55%	0.278
Toffeee 125g	29	€1.35	€2.89	€1.60	€0.45	€1.54	114.07%	0.278
Aspirin 500mg (20 Tabletten)	9	€3.80	€7.49	€5.71	€1.50	€3.69	97.11%	0.263
Airwaves Kaugummi Cool Cassis 12 Stück	22	€0.69	€1.59	€1.02	€0.26	€0.90	130.43%	0.255
Baby Einstein Magic Touch Piano	32	€23.99	€69.99	€33.39	€8.39	€46.00	191.75%	0.251
WMF Toaster Stelio Edelstahl	15	€36.85	€69.99	€46.88	€10.95	€33.14	89.93%	0.234
Pom-Bär Original 75g	32	€0.79	€2.59	€1.22	€0.28	€1.80	227.85%	0.226
Milka Alpenmilch 100g	20	€0.55	€1.70	€1.11	€0.22	€1.15	209.09%	0.198
Haribo Goldbären 200g	20	€0.65	€1.18	€0.87	€0.17	€0.53	81.54%	0.195
Tempo Taschentücher 30 x 10 Stück	22	€2.85	€4.51	€3.17	€0.57	€1.66	58.25%	0.180
Uncle Ben's Express Langkornreis 250g	18	€1.29	€2.49	€1.76	€0.31	€1.20	93.02%	0.178
JBL Flip 5	30	€84.90	€156.25	€103.43	€17.73	€71.35	84.04%	0.171
Ritter Sport Voll-Nuss 100g	28	€1.36	€2.69	€1.46	€0.25	€1.33	97.79%	0.168
Ritter Sport Alpenmilch 100g	20	€0.69	€1.39	€1.19	€0.18	€0.70	101.45%	0.151
Milka Luflee Schokolade 100g	9	€0.69	€1.29	€1.13	€0.17	€0.60	86.96%	0.148
Airwaves Strong Kaugummi 12 Stück	9	€0.75	€1.10	€0.92	€0.13	€0.35	46.67%	0.145
Pantene PRO-V Repair & Care 300ml	10	€1.99	€2.99	€2.67	€0.36	€1.00	50.25%	0.136
Dr. Oetker Ristorante Pizza Salame 320g	17	€1.79	€2.99	€2.75	€0.36	€1.20	67.04%	0.133
Big Bobby Car Classic Sansibar	9	€45.85	€64.90	€55.12	€6.87	€19.05	41.55%	0.125
Lindt Lindor Kugel Milch 100g	11	€2.04	€2.99	€2.75	€0.31	€0.95	46.57%	0.113
FIFA 21 (Playstation 4)	39	€49.95	€80.20	€61.58	€6.85	€30.25	60.56%	0.111
Maggi Ravioli in Tomatensauce 800g	15	€1.39	€2.49	€2.00	€0.22	€1.10	79.14%	0.108
PS4 Wireless Dualshock Controller, V2	43	€48.98	€76.31	€58.72	€5.21	€27.33	55.80%	0.089
FIFA 22 (Playstation 5)	11	€59.55	€79.99	€71.90	€6.28	€20.44	34.32%	0.087
Duschdas Duschgel Sport 2-in-1 250ml	29	€1.25	€1.75	€1.29	€0.11	€0.50	40.00%	0.084
Nintendo Switch	37	€306.87	€421.28	€335.88	€26.25	€114.41	37.28%	0.078
Head&Shoulders Classic Clean 300ml	20	€3.50	€4.29	€3.91	€0.17	€0.79	22.57%	0.044
KTM Radical Kids Training Bike	7	€116.00	€129.99	€118.07	€4.92	€13.99	12.06%	0.042
Nutella Nuss-Nugat-Creme 450g	11	€2.99	€3.29	€3.06	€0.11	€0.30	10.03%	0.036
<b>Total</b>	<b>692</b>							<b>0.203</b>

# = Number of observations; Min = Minimum; Max = Maximum;  $\bar{x}$  = Arithmetic mean;  $\sigma$  = Standard deviation; CV = Coefficient of variation.

Finally, the brick-and-mortar retailers and the online retailers are also analyzed jointly, taking into account the shipping costs incurred to transport the goods to the corresponding place (Table 8). Here, 11 price comparisons are documented with 171 individual price observations. At brick-and-mortar retailers, a good can be purchased directly at the called retail price. Online retailers may charge additional shipping costs to transport the goods to the end customer. As a result, the maximum selling

<sup>1</sup> Here, the special offer price also documented in the study is noted.

price at online retailers increases due to the inclusion of shipping costs, while the selling price at brick-and-mortar retailers remains constant.

This is particularly noticeable when determining the coefficient of variation for the product "Milka Alpenmilch 100g". Here, the standard deviation of €2.68 is greater than the arithmetic mean of €2.53, resulting in a coefficient of variation of 1.059. The maximum price here is more than 18 times higher than the selling price of the cheapest supplier. The percentage price range of 1,721.82% also impressively shows that there is a particularly strong deviation from an equilibrium price in this price comparison.

Overall, the joint analysis of brick-and-mortar retailers and online retailers including shipping costs shows a significantly higher average coefficient of variation of 0.416. An equilibrium price cannot be observed in the aggregated analysis of brick-and-mortar retailers and online retailers including shipping costs either.

**Table 8:** Comparison of prices collected in stores and online including shipping costs

Product	#	Min	Max	$\bar{x}$	$\sigma$	Absolute price range	Percentage price range	CV
Milka Alpenmilch 100g	20	€0.55	€10.02	€2.53	€2.68	€9.47	1,721.82%	1.059
Ritter Sport Alpenmilch 100g	20	€0.69	€6.19	€1.88	€1.63	€5.50	797.10%	0.866
Haribo Goldbären 200g	20	€0.65	€8.13	€3.50	€2.90	€7.48	1,150.77%	0.829
Uncle Ben's Express Langkornreis 250g	18	€1.29	€9.48	€2.92	€2.34	€8.19	634.88%	0.800
Head&Shoulders Classic Clean 300ml	20	€3.50	€10.49	€5.20	€2.23	€6.99	199.71%	0.429
Baby Einstein Magic Touch Piano	32	€26.98	€69.99	€37.31	€8.04	€43.01	159.41%	0.216
Big Bobby Car Classic Sansibar	9	€49.75	€64.90	€56.22	€5.96	€15.15	30.45%	0.106
Aspirin 500mg (20 Tabletten)	9	€6.45	€8.74	€7.73	€0.70	€2.29	35.50%	0.091
Vilsa Classic 12 x 0,7l Kasten <sup>2</sup>	6	€4.92	€5.99	€5.30	€0.38	€1.07	21.75%	0.072
KTM Radical Kids Training Bike	6	€116.08	€135.94	€120.24	€7.43	€19.86	17.11%	0.062
Toniebox Starterset inkl. Kreativtonie	11	€71.76	€83.43	€78.01	€3.29	€11.67	16.26%	0.042
<b>Total</b>	<b>171</b>							<b>0.416</b>

# = Number of observations; Min = Minimum; Max = Maximum;  $\bar{x}$  = Arithmetic mean;  $\sigma$  = Standard deviation; CV = Coefficient of variation.

Looking at the results as a whole, it becomes clear that the price comparisons in brick-and-mortar retailing with a mean coefficient of variation of 0.145 are clearly far from an equilibrium price. However, the setting of equilibrium prices is not observed at all, with the exception of three price comparisons with a low number of price observations in each case.

Looking at online retail, the average coefficient of variation is 0.219 (without taking shipping costs into account) and 0.200 (with taking shipping costs into account). Here it is already clear that the prices are

<sup>2</sup> The minimum order value is higher than the observed price for one retailer.

more widely spread and that there is a greater deviation from an equilibrium price online than in stationary retail.

The joint analysis of brick-and-mortar retailers and online retailers shows an average coefficient of variation of 0.203 (without taking shipping costs into account) and 0.416 (with taking shipping costs into account). The mean coefficient of variation with shipping costs taken into account shows a significant deviation from an equilibrium price. This may be due to the fact that the shipping costs charged by an online retailer result in a higher maximum price, while the sales price remains constant for stationary retailers. This results in a higher overall price spread between brick-and-mortar retailers and online retailers, which leads to a greater deviation from an equilibrium price.

## **5. Discussion**

Empirical results of the past 60 years clearly show that equilibrium prices do not occur, even for absolutely homogeneous goods. This is true even if one sets narrow geographic boundaries (a city) and considers only short time periods (< 1 day).

The neoclassical market model can be decomposed into three main components: 1. Aggregate supply function, 2. Aggregate demand function, 3. Equilibrium price. As already stated in the introduction, the first two main components escape empirical observation. This is because both suppliers and demanders have clearly discernible motives for never giving honest, but always strategically distorted information about their willingness to supply or demand at different price levels.

Therefore, the focus of empirical research on the neoclassical market model must be on observing price differences. The research results presented here support the findings of numerous previous studies. With very few exceptions, no equilibrium price emerges.

One might have expected that the increased importance of the Internet would contribute to a reduction in search costs and information costs, so that the empirically observable price deviations would decrease significantly. However, the price observations presented here do not indicate this at all.

Contrary to what the neoclassical market model suggests, we are dealing with a highly fragmented market. Even at one place and at one time, transactions of a homogeneous good are carried out at quite different prices. Aggregation of demand and aggregation of supply do not occur in reality. The demanders do not act as a group. Instead, with their respective demands they are fragmented into small groups or even completely isolated from the other demanders. The situation is no different for suppliers. They, too, do not act as a group. Their offerings are also fragmented or even isolated. No retailer has an overview of the entire demand. No customer has an overview of all the suppliers. Thus,

some suppliers always meet some demanders without knowing or paying attention to the overall situation of aggregated supply and aggregated demand. Individual demands meet individual offers in a completely unconnected and uncoordinated way. This leads to transactions that show entirely different price levels - even for completely homogeneous goods, even at one and the same place and at one and the same time.

The reasons for this structural market fragmentation lie primarily in the non-fulfillment of the model assumptions of the neoclassical market model. In economic reality, there are herd behavior, strategic behavior, asymmetric information distributions, externalities, search costs, information costs, negotiation costs, decision costs, monitoring costs, and enforcement costs. Real economic agents are, as a rule, far from rationally seeking their pecuniary utility maximum. On the contrary, many people tend to behave irrationally at least occasionally. They accept higher prices because a store offers nice parking spaces, because they like the shopkeeper or because they are happy to chat with the nice staff from time to time.

The neoclassical market model is unquestionably the best-known and most influential model that economic science has ever produced. Even economic laymen know the representation of the aggregate demand function, the aggregate supply function, and the formation of an equilibrium price. But what is left of this model if two main components are not empirically observable and empirical observations of the third main component regularly point to the conclusion that market activity is inaccurately described by the neoclassical market model? A sober assessment must lead to the conclusion that the neoclassical market model consists to one half of wishful thinking and to the other half of (more or less esoteric) beliefs. The neoclassical market model thus appears to belong to the same category as the unicorn, the Yeti, and the Loch Ness monster.

This sobering finding makes two consequences inevitable:

1. Economic theory must produce a new market model that adequately reflects the fragmentation of markets. So far, economic research has been too comfortable. It is often conceded that the neoclassical market model does not (quite) accurately describe reality. But in the same breath, the view is often expressed that, on the whole, things will probably work out more or less as in this model. This attitude, however, is unworthy of a science. The equilibrium price is said to have a steering function. This steering function is connected with an efficiency expectation. If, however, no equilibrium price is achieved, the assumed steering function of the price does not occur, and the efficiency promise remains unfulfilled. Real markets thus deviate fundamentally from the neoclassical market model. For this reason, it is wrong to consider market

orientation as the solution to almost all economic problems, as the protagonists of the Austrian School have done in the past 100 years.

2. Economic policy must no longer follow the efficiency promise of market orientation. Generations of economic policymakers believed that the establishment of market mechanisms would automatically lead to efficient outcomes. Public health policy in Germany can be seen as an example of the failure of this approach. For about 40 years, every Minister of Health has been given the task of ensuring more competition in the healthcare system and thus contributing to cost containment. In the course of this market orientation, many hospitals were privatized and competition between hospitals was stimulated. It was hoped that this would uncover hidden reserves of personnel and materials and lead to more efficient and cost-effective healthcare. The result, however, was that highly remunerated healthcare services in particular were performed more frequently and that costs in the hospital system continued to rise unchecked. In 2019, 315 artificial hip joints were implanted per 100,000 inhabitants in Germany. That is almost twice as many interventions as the average for OECD countries, where only 174 corresponding operations per 100,000 inhabitants occurred in 2019 (OECD, 2021). In a sector as strongly characterized by asymmetric information distributions as the healthcare sector, competition cannot lead to efficient market outcomes. A patient cannot independently judge whether an artificial hip joint is the appropriate treatment. A patient must rely on the judgment of a physician. If, however, the latter is encouraged to perform as many hip operations as possible by means of correspondingly high remuneration, competition between hospitals will not lead to greater efficiency, but rather to increasing misuse in public healthcare.

In view of the empirical results presented in this study, we should address these challenges in economic theory and economic policy with great commitment.

## **6. Summary**

The neoclassical market model enjoys great popularity and continuous dissemination in academic teaching. In the neoclassical market model, rising prices mean that suppliers are more willing to provide goods. At the same time, however, rising prices reduce the willingness of demanders to purchase these goods. The resulting aggregate supply and demand function form an intersection which characterizes the equilibrium price and, according to the theory, leads to market clearing. The neoclassical market model, however, has a weakness in its model assumptions, which often cannot be regarded as fulfilled in reality.

This study aims to empirically test the validity of the neoclassical market model and to determine whether a neoclassical market can be observed in reality. For this purpose, price observations of homogeneous goods within a narrow geographical area at a specific point in time are conducted and analyzed. According to the neoclassical market model, a homogeneous good should have an equilibrium price and be traded at the same price by different sellers within a spatially and temporally delimited market. In academic discourse, similar price observations have repeatedly revealed widely varying prices for homogeneous goods (see, for example, Vukina & Zheng, 2010; Brynjolfsson & Smith, 2000; Borenstein & Rose, 1994; Dahlby & West, 1986; Pratt, Wise & Zeckhauser, 1979). Not only the massive political and societal influences on markets with the beginning of the 2020s (Covid19 pandemic, collapse of international supply chains, war in Ukraine, etc.), but also the progressive development of online trade mean that the validity of empirical findings has to be permanently verified by science.

Between October 2020 and May 2022, students at Ostfalia University of Applied Sciences in Wolfsburg conduct 146 price comparisons for 77 different goods with a total of 2,217 individual price observations. They record 59 price comparisons for food items, 47 price comparisons for drugstore items, and 40 price comparisons for other products. The price comparisons take place both in brick-and-mortar retail and in online retail. We analyze the recorded prices both separately for each type of retail and aggregated, and also consider the impact of any shipping costs that may apply. We consider the percentage price range of the observed goods and determine the coefficients of variation to analyze the extent of deviation from an equilibrium price.

It turns out that in 143 out of 146 price comparisons, the percentage price range, the standard deviation, and the coefficient of variation are non-zero. The other three price comparisons are based on very few observations. In another study analyzed, a second price comparison was carried out for one of these three goods with a significantly higher number of individual price observations, and it was found that an equilibrium price cannot be observed. According to our data, the setting of an equilibrium price for a homogeneous good cannot be observed in a spatially and temporally delimited market ( $p$ -value of one-sample  $t$ -test = 0.000).

The strongest deviation from an equilibrium price is found in the aggregated analysis of brick-and-mortar and online retail including shipping costs with a coefficient of variation of 0.416. In brick-and-mortar retailing only, we find the smallest deviation from an equilibrium price with a coefficient of variation of 0.145. The fact that online retailers can operate in the same geographic area as brick-and-mortar retailers seems to result in a stronger deviation from an equilibrium price overall.

Our results are consistent with previous academic findings in the literature. Despite recent massive political and social influences on markets, our results support previous empirical findings that do not

observe an equilibrium price according to the neoclassical market model in reality. Transactions of homogeneous goods are carried out at different prices. In contrast to the neoclassical market model, market activity in reality is highly fragmented. There is no aggregation of supply and demand. Suppliers do not act as one group, within suppliers there are many groups that act separately. Consumers do not act as one group either, within consumers there are also many groups that act separately from each other. The entirety of supply and demand cannot be processed by individual actors. As a result, transactions occur at different price levels, even though the goods in question are homogeneous.

Economic theory must take the fragmentation of markets adequately into account and produce a new market model. Economic policy should immediately abandon the naïve notion that the establishment of market mechanisms alone will produce efficient results.

## References

- Aalto-Setälä, V. (2003), Explaining price dispersion for homogeneous grocery products, *Journal of Agricultural & Food Industrial Organization*, 1(1), 1-16.
- Baye, M. R., Morgan, J., & Scholten, P. (2006), Persistent price dispersion in online markets, in: Jansen, D. (Hrsg.), *The New Economy and Beyond: Past, Present and Future*, Edward Elgar, Northampton.
- Baye, M. R., Morgan, J., & Scholten, P. (2004), Price dispersion in the small and in the large: Evidence from an internet price comparison site, *The Journal of Industrial Economics*, 52(4), 463-496.
- Beck, O., & Ülker, S.-L. (2022), Empirische Erforschung des Preismechanismus, *Wolfsburg Invisible Hand Studies*, WIHSt No. 8.
- Borenstein, S., & Rose, N. L. (1994), Competition and price dispersion in the US airline industry, *Journal of Political Economy*, 102(4), 653-683.
- Bridel, P. (1997). *Money and General Equilibrium Theory: From Walras to Pareto (1870-1923)*, Edward Elgar Publishing, Cheltenham.
- Brown, J. R., & Goolsbee, A. (2002), Does the Internet make markets more competitive? Evidence from the life insurance industry, *Journal of political economy*, 110(3), 481-507.
- Burdett, K., & Judd, K. L. (1983), Equilibrium price dispersion, *Econometrica: Journal of the Econometric Society*, 51(4), 955-969.
- Brynjolfsson, E., & Smith, M. D. (2000), Frictionless commerce? A comparison of Internet and conventional retailers, *Management Science*, 46(4), 563-585.
- Chmielewski, L., & Kunzmann, O. (2021), Einführung in die empirische Forschung am Beispiel des Preismechanismus und der Bildung von Gleichgewichtspreisen, *Wolfsburg Invisible Hand Studies*, WIHSt No. 4.
- Clar, F., Petrunina, J., Qitaku, A., & Zubke, L. (2021), Empirische Erforschung des Preismechanismus, *Wolfsburg Invisible Hand Studies*, WIHSt No. 3.
- Dahlby, B., & West, D. S. (1986), Price dispersion in an automobile insurance market, *Journal of Political Economy*, 94(2), 418-438.
- Flemming, J., Boztepe, C., & Tawbe, S. (2021), Zur empirischen Preisforschung – Neoklassisches Marktmodell, *Wolfsburg Invisible Hand Studies*, WIHSt No. 6.
- Hong, H., & Shum, M. (2006), Using price distributions to estimate search costs, *The RAND Journal of Economics*, 37(2), 257-275.
- Kessner, E., & Polborn, M. K. (2000), A new test of price dispersion, *German Economic Review*, 1(2), 187-220.
- Kornhardt, C. (2021), Empirische Untersuchung des neoklassischen Marktmodells anhand des Gleichgewichtspreises, *Wolfsburg Invisible Hand Studies*, WIHSt No. 1.
- Lach, S. (2002), Existence and persistence of price dispersion: an empirical analysis, *Review of Economics and Statistics*, 84(3), 433-444.
- Lewis, M. (2008), Price Dispersion and Competition with Differentiated Sellers, *Journal of Industrial Economics*, 56(3), 654-678.

- Mankiw, N. G., & Taylor, M. P. (2020), *Economics*, 5th Edition, Cengage Learning EMEA, Andover.
- Maynes, E. S. (1976), *Decision-Making for Consumers: An Introduction to Consumer Economics*, New York/London.
- Mises, L. von (1929), *Kritik der Interventionismus, Untersuchungen zur Wirtschaftspolitik und Wirtschafts-ideologie der Gegenwart*, Fischer, Jena.
- Mises, L. von (1940), *Nationalökonomie, Theorie des Handelns und Wirtschaftens*, Editions Union, Genf.
- Möbius, D., Schmidt, M., & Waldhelm, S. (2021), Empirische Studie zum Thema Invisible Hand, *Wolfs- burg Invisible Hand Studies*, WIHSt No. 5.
- Moen, E. R., Wulfsberg, F., & Aas, Ø. (2020), Price Dispersion and the Role of Stores, *The Scandinavian Journal of Economic*, 122(3), 1181-1206.
- OECD (2021), *Health at a Glance 2021: OECD Indicators*, OECD Publishing, Paris.
- Ötsch, W. O. (2019), *Mythos Markt, Mythos Neoklassik: Das Elend des Marktfundamentalismus*, Metropolis, Marburg.
- Pindyck, R. S., & Rubinfeld, D. L. (2017), *Microeconomics*, 9th Edition, Pearson Education, London.
- Pratt, J. W., Wise, D. A., & Zeckhauser, R. (1979), Price differences in almost competitive markets, *The Quarterly Journal of Economics*, 93(2), 189-211.
- Samuelson, P. A. (1948), *Economics: An Introductory Analysis*, McGraw-Hill, New York City.
- Samuelson, P. A., & Nordhaus, W. D. (2009), *Economics*, 19th Edition, McGraw-Hill, New York City.
- Scholten, P., & Smith, S. A. (2002), Price dispersion then and now: Evidence from retail and e-tail mar- kets, *The Economics of the Internet and E-commerce*, 11, 63-88.
- Smith, A. (1776), *An Inquiry into the Nature and Causes of the Wealth of Nations*, London.
- Sorensen, A. T. (2000), Equilibrium price dispersion in retail markets for prescription drugs, *Journal of Political Economy*, 108(4), 833-850.
- Stigler, G. J. (1961), The economics of information. *Journal of political economy*, 69(3), 213-225.
- Van Hoomissen, T. (1988), Price dispersion and inflation: Evidence from Israel, *Journal of Political Econ- omy*, 96(6), 1303-1314.
- Varian, H. R. (2014), *Intermediate Microeconomics: A Modern Approach*, 8th Edition, Norton, New York City.
- Vukina, T., & Zheng, Z. (2010), Bargaining, Search, and Price Dispersion: Evidence from the Live Hogs Market, *Agricultural and Resource Economics Review*, 39(3), 534-546.
- Wahlers, J., & Schulenburg, S. von der (2022), Empirische Erforschung des Preismechanismus, *Wolfs- burg Invisible Hand Studies*, WIHSt No. 9.
- Walker, D. A. (1993), Walras's Models of the Barter of Stocks of Commodities. *European Economic Re- view*, 37(7), 1425-1446.
- Wenzlaff, L., & Leohold, S. (2022), Empirische Preisforschung – Neoklassisches Marktmodell, *Wolfs- burg Invisible Hand Studies*, WIHSt No. 7.

- Wildenbeest, M.R. (2011), An empirical model of search with vertically differentiated products, *The RAND Journal of Economics*, 42(4), 729-757.
- Yavuz, D. (2021), Der Preisbildungsprozess – Eine kritische Betrachtung der neoklassischen Theorie, *Wolfsburg Invisible Hand Studies*, WIHSt No. 2.
- Younis, R., & Sokolowski, P. (2022), Empirische Studie zur Erforschung des Preismechanismus, *Wolfsburg Invisible Hand Studies*, WIHSt No. 10.
- Ziegner, K., & Mützel, P. (2022), Empirische Erforschung des Preismechanismus, *Wolfsburg Invisible Hand Studies*, WIHSt No. 11.

## Appendix

**Table A-1:** Summary of price comparisons

Product	Number of price comparisons	Number of prices	WIHSt No.
<b>Category „Drugstore“</b>	<b>47</b>	<b>634</b>	<b>-</b>
Algemarina Trockenshampoo 200ml	2	9	6
Aptamil "Pronatura PRE" 800g	1	5	6
Bebe "Creme Intensivpflege" 50ml	3	14	6
Duschdas Duschgel Sport 2-in-1 250ml	2	35	3, 5
Duschgel Kneipp "Lebensfreude"	3	32	4
Head&Shoulders Apple Fresh 300ml	1	13	10
Head&Shoulders Classic Clean 300ml	2	40	8
Hipp "Ultra Sensitiv" Feuchttücher 4er Pack	1	4	6
Hipp "Zart Pflegend" Feuchttücher 4er Pack	1	4	6
I Love Extreme Mascara "Volume"	3	15	6
Nivea Deoroller Fresh pure 0%	3	25	11
Nivea Dry Impact Deo 150ml	1	7	5
Nivea Soft 200ml	3	29	10
Odol-med3 Zahnpasta Extra White 125ml	1	20	10
Pampers "Baby Dry" 21 Stück	1	3	6
Pampers "Premium Protection" 26 Stück	3	24	6
Pantene PRO-V Repair & Care 300ml	1	10	7
Pflaster Hansaplast "Classic"	3	44	4
Pril Kraftgel Ultra Plus	1	19	9
Schauma 7 Kräuter Shampoo	1	17	9
Tempo Taschentücher 30 x 10 Stück	1	22	10
UHU Kleber 21g	6	201	2
Zahnpasta Elmex "Kariesschutz"	3	42	4
<b>Category „Food“</b>	<b>59</b>	<b>776</b>	<b>-</b>
Airwaves Kaugummi Cool Cassis 12 Stück	1	22	10
Airwaves Strong Kaugummi 12 Stück	1	9	3
Barilla Penne Rigate 500g	1	6	5
Coca-Cola Original Taste 0,33l	1	17	10
Dr. Oetker Ristorante Pizza Salame 320g	2	25	5, 9
Extra Professional White Kaugummi 50 Stück	1	12	3
Funny-frisch „Ungarisch“ 175g	2	24	1, 3
Géramont „Classic“ 200g	1	6	1
Haribo Goldbären 200g	2	40	8
Haribo Happy Cola 200g	1	10	3
Heineken Pils 6 x 0,33l	1	10	1
Honig Langnese "Flotte Biene" 250g	3	19	4
Jägermeister 0,7l	1	9	5
Konfitüre Schwartzau Extra Erdbeere 340g	3	21	4
Leibniz Keks'N Crem Choco 228g	1	9	3
Lindt Lindor Kugel Milch 100g	1	11	3
Maggi Ravioli in Tomatensauce 800g	1	15	9
Maggi Würze 250g	1	20	8
Milka „Haselnusschokolade“ 100g	1	6	1
Milka Alpenmilch 100g	3	50	5, 8
Milka Luflee Schokolade 100g	1	9	7
Niemand Dry Gin 0,5l	6	101	2
Nutella Nuss-Nugat-Creme 450g	4	32	3, 4
Pom-Bär Original 75g	1	32	3
Pringles „Original“ 200g	2	21	1, 5
Pringles Chips Sour Cream & Onion 200g	1	13	3
Red Bull Classic 250ml	5	53	1, 3, 11
Red Bull Sugarfree 250ml	1	19	9

Ritter Sport Alpenmilch 100g	2	40	8
Ritter Sport Voll-Nuss 100g	1	28	3
Snickers 50g	2	16	2
Toffifee 125g	1	29	3
Uncle Ben's Express Langkornreis 250g	2	36	8
Vilsa Classic 12 x 0,7l Kasten	1	6	5
<b>Category „Other“</b>	<b>40</b>	<b>807</b>	<b>-</b>
AirPods 2. Gen. / MV7N2ZM/A	6	338	2
Aspirin 500mg (20 Tabletten)	2	18	5
Baby Einstein Magic Touch Piano	2	64	7
Big Bobby Car Classic Sansibar	2	18	7
Converse Chuck Taylor All Star High	3	29	11
FIFA 21 (Playstation 4)	1	39	1
FIFA 22 (Playstation 5)	1	11	5
HP 302 Cyan/Magenta/Gelb Druckerpatrone	3	35	11
JBL Flip 5	1	30	1
KTM Radical Kids Training Bike	2	13	7
Nintendo Switch	1	37	1
PS4 Wireless Dualshock Controller, V2	1	43	1
Sony Playstation 5 Disc Version	1	5	6
TomTom "Go Discover 7"	2	14	6
Toniebox Starterset inkl. Kreativtonie	1	11	7
UNO Standard	3	31	11
WMF Kult X Mix & Go 0,6l	5	47	5, 11
WMF Toaster Stelio Edelstahl	1	15	9
Xiaomi Scooter 1S	2	9	6
<b>Total</b>	<b>146</b>	<b>2,217</b>	<b>-</b>

**Table A-2: Product descriptions in English**

<b>Product name</b>	<b>English description</b>
<b>Category „Drugstore“</b>	
Algemarina Trockenshampoo 200ml	Dry shampoo
Aptamil "Pronatura PRE" 800g	Baby food
Bebe "Creme Intensivpflege" 50ml	Moisturizer
Duschdas Duschgel Sport 2-in-1 250ml	Shower gel
Duschgel Kneipp "Lebensfreude"	Shower gel
Head&Shoulders Apple Fresh 300ml	Shampoo
Head&Shoulders Classic Clean 300ml	Shampoo
Hipp "Ultra Sensitiv" Feuchttücher 4er Pack	Wet wipes
Hipp "Zart Pflegend" Feuchttücher 4er Pack	Wet wipes
I Love Extreme Mascara "Volume"	Mascara
Nivea Deoroller Fresh pure 0%	Deodorant stick
Nivea Dry Impact Deo 150ml	Deodorant spray
Nivea Soft 200ml	Moisturizer
Odol-med3 Zahnpasta Extra White 125ml	Toothpaste
Pampers "Baby Dry" 21 Stück	Diapers
Pampers "Premium Protection" 26 Stück	Diapers
Pantene PRO-V Repair & Care 300ml	Hair care product
Pflaster Hansaplast "Classic"	Plaster
Pril Kraftgel Ultra Plus	Dishwashing detergent
Schauma 7 Kräuter Shampoo	Shampoo
Tempo Taschentücher 30 x 10 Stück	Tissues
UHU Kleber 21g	Glue
Zahnpasta Elmex "Kariesschutz"	Toothpaste
<b>Category „Food“</b>	
Airwaves Kaugummi Cool Cassis 12 Stück	Chewing gum
Airwaves Strong Kaugummi 12 Stück	Chewing gum
Barilla Penne Rigate 500g	Pasta
Coca-Cola Original Taste 0,33l	Soft drink
Dr. Oetker Ristorante Pizza Salame 320g	Pizza
Extra Professional White Kaugummi 50 Stück	Chewing gum
Funny-frisch „Ungarisch" 175g	Potato chips
Géramont „Classic" 200g	Cheese
Haribo Goldbären 200g	Jelly sweets
Haribo Happy Cola 200g	Jelly sweets
Heineken Pils 6 x 0,33l	Beer
Honig Langnese "Flotte Biene" 250g	Honey
Jägermeister 0,7l	Liquor
Konfitüre Schwartau Extra Erdbeere 340g	Jam
Leibniz Keks'N Crem Choco 228g	Cookies
Lindt Lindor Kugel Milch 100g	Chocolate
Maggi Ravioli in Tomatensauce 800g	Pasta
Maggi Würze 250g	Sauce
Milka „Haselnusschokolade" 100g	Chocolate
Milka Alpenmilch 100g	Chocolate
Milka Lufée Schokolade 100g	Chocolate
Niemand Dry Gin 0,5l	Liquor
Nutella Nuss-Nugat-Creme 450g	Hazelnut spread
Pom-Bär Original 75g	Potato chips
Pringles „Original" 200g	Potato chips
Pringles Chips Sour Cream & Onion 200g	Potato chips
Red Bull Classic 250ml	Energy drink
Red Bull Sugarfree 250ml	Energy drink
Ritter Sport Alpenmilch 100g	Chocolate
Ritter Sport Voll-Nuss 100g	Chocolate

Snickers 50g	Chocolate bar
Toffifee 125g	Caramel candy
Uncle Ben's Express Langkornreis 250g	Rice
Vilsa Classic 12 x 0,7l Kasten	Mineral water

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**Category „Other“**

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AirPods 2. Gen. / MV7N2ZM/A	Earphones
Aspirin 500mg (20 Tabletten)	Medicine
Baby Einstein Magic Touch Piano	Piano
Big Bobby Car Classic Sansibar	Toy car
Converse Chuck Taylor All Star High	Shoes
FIFA 21 (Playstation 4)	Video game
FIFA 22 (Playstation 5)	Video game
HP 302 Cyan/Magenta/Gelb Druckerpatrone	Printer cartridge
JBL Flip 5	Portable speaker
KTM Radical Kids Training Bike	Bike
Nintendo Switch	Game console
PS4 Wireless Dualshock Controller, V2	Game controller
Sony Playstation 5 Disc Version	Game console
TomTom "Go Discover 7"	Navigation device
Toniebox Starterset inkl. Kreativtonie	Toy
UNO Standard	Card game
WMF Kult X Mix & Go 0,6l	Blender
WMF Toaster Stelio Edelstahl	Toaster
Xiaomi Scooter 1S	Electric scooter

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