

Research Article / Araştırma Makalesi

NEW INFLATION PHENOMENA FROM A BEHAVIORAL ECONOMICS PERSPECTIVE: A THEORETICAL MODELING APPROACH

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ABSTRACT

In the post-Covid-19 period, global inflation has surged due to suppressed demand, supply chain disruptions, rising costs, regional conflicts, and energy crises. What distinguishes this recent wave of inflation from previous episodes is its diverse and evolving nature. Emerging concepts such as greedflation, shrinkflation, and skimpflation, which have recently emerged in the literature and remain topical, have been observed across various countries and sectors. Drawing on insights from relevant studies, this paper brings together critiques of neoclassical assumptions with behavioral economics theories concerning firm and consumer decision-making processes. A theoretical model is proposed that reconsiders profit and utility maximization through a behavioral economics lens. Unlike previous studies, this research aims to establish a novel link between recent inflation phenomena and behavioral economics. The consumer utility function and the firm profit function constructed through agent-based modeling consist of variables that are consistent with the framework of behavioral economics. In the proposed model, the assumptions of rational profit and utility maximization in classical economics are questioned; it is argued that consumer decisions are shaped by heuristic judgments, asymmetric information, and perceptions of inflation, while producer behavior is influenced by factors such as greedflation, shrinkflation, and skimpflation.

Keywords: Greedflation, Shrinkflation, Skimpflation, Behavioral Economics, Inflation

JEL Classification: D11, D81, D91

DAVRANIŞSAL İKTİSAT PERSPEKTİFİ İLE YENİ ENFLASYON OLGULARI: KURAMSAL BİR MODELLEME YAKLAŞIMI

ÖZET

Covid-19 sonrası dönemde, bastırılmış talep, tedarik zinciri aksamaları, artan maliyetler, bölgesel çatışmalar ve enerji krizleri gibi nedenlerle küresel enflasyon hızla artmıştır. Bu son enflasyon dalgasını önceki dönemlerden ayıran temel unsur, daha çeşitli ve değişken biçimler almasıdır. Greedflasyon, shrinkflasyon ve skimpflasyon gibi kavramlar, yakın zamanda literatüre girmiş ve güncelliğini koruyan kavramlar olup birçok ülke ve sektörde gözlemlenmiştir. Bu çalışma, ilgili çalışmalardan elde edilen bulgularla, firmaların ve tüketicilerin karar alma süreçlerine dair neoklasik varsayımların eleştirisini yapan davranışsal iktisat teorilerini bir araya getirmektedir. Kar ve fayda maksimizasyonu kavramlarını davranışsal iktisat çerçevesinde yeniden değerlendiren kuramsal bir model önerilmektedir. Bu araştırma, literatürden farklı olarak, yeni enflasyon olguları ile davranışsal iktisat arasında özgül bir bağ kurmayı

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amaçlamaktadır. Ajan temelli modelleme ile kurulan, tüketici fayda fonksiyonu ve firma kar fonksiyonu, davranışsal iktisat çerçevesine uygun olan değişkenlerden oluşturulmuştur. Önerilen modelde, klasik iktisadın rasyonel kar ve fayda maksimizasyonu varsayımları sorgulanmakta; tüketici kararlarının sezgisel yargılar, asimetrik bilgi ve enflasyon algısıyla şekillendiği; üretici davranışlarının ise greedflasyon, shrinkflasyon ve skimpflasyon gibi unsurların etkisi altında olduğu ileri sürülmektedir.

Anahtar Kelimeler: Greedflasyon, Shrinkflasyon, Skimpflasyon, Davranışsal İktisat, Enflasyon
JEL Sınıflandırması: D11, D81, D91

1. Introduction

Inflation is a phenomenon that has long held a significant place in maintaining economic stability and has been influential in shaping economic policies. Rapid increases in the general level of prices lead to a decrease in purchasing power, a decline in the standard of living, and a pessimistic trend in future expectations. The economic effects of the recent COVID-19 pandemic, energy crises, and global supply chain disruptions have led to an inflationary environment affecting the entire world (Yang & Fu, 2025: 4). With the combination of these factors, new concepts have emerged that, while not entirely disconnected from the traditional notion of inflation, differ in terms of their effects. Shrinkflation, skimpflation, and greedflation have begun to enter the literature and be included in research (Kireeva, 2022: 3).

The integration of economics with mathematics in the past century and the intensive production of studies based on mathematical results in economics have led to the neglect of the social and behavioral aspects of human beings. Behavioral economics has investigated the role of these aspects in economic decision-making. George Katona, who first used the term behavioral economics in 1951, is considered a pioneer in this field. The views and studies of Daniel Kahneman and Richard Thaler have made significant contributions to the theoretical foundation of behavioral economics. For this reason, the theoretical framework of this study is based on the views of Kahneman and Thaler.

In this study, the emergence of new types of inflation is evaluated in terms of the behavioral factors that influence the decision-making processes of economic agents, and this relationship is examined within the framework of behavioral economics. Behavioral economics places the bounded rationality, intuitions, and biases of firms and individuals—in other words, buyers and sellers—at the center of decision-making processes (Kahneman & Tversky, 1979; Thaler, 1980). In the context of the theoretical background, it is questioned why firms resort to practices such as skimpflation or shrinkflation instead of directly reflecting the effects of costs or other factors on prices. The extent to which behavioral factors influence these strategies adopted by firms is examined.

Systematic examinations of the behavioral basis of the concepts of shrinkflation, skimpflation, and greedflation are addressed in detail both in terms of their theoretical foundations and their place in existing studies. For this purpose, due to the limited number of studies in this field in our country, international databases publishing scientific research such as Google Scholar, Web of Science, Coar, and SSRN have been reviewed. It has been investigated how these concepts are shaped by the strategies of firms pursuing profit maximization in response to the perceptions and reactions of consumers aiming for utility maximization. Based on in-

ternational studies and those reflecting these concepts in Türkiye, a theoretical discussion has been attempted. In this study, it is aimed to offer a new perspective to the field by evaluating the relatively less-studied new types of inflation in the existing literature from a behavioral economics perspective. Through the agent-based modeling approach, it has been attempted to determine how the new inflation concepts are situated within the theoretical ground of behavioral economics.

2. Inflation and Behavioral Economics

Inflation is one of the phenomena that is frequently emphasized in terms of its causes and consequences. Although it is a phenomenon extensively studied in the literature, both causal and descriptive definitions have been made (Demirgil, 2019: 14). Continuous increases in the general level of prices, the persistence of these increases over time, decreases in the purchasing power of money, and the faster growth of total demand compared to total supply are among the definitions that can be made for inflation (Cesur, 2006: 87). Addressed as a monetary phenomenon within the classical economics approach, inflation has been explained by reasons such as uncontrolled monetary expansion, increases in costs, and imbalances in supply and demand. In the last five-year period, new inflation concepts that differ from traditional inflation approaches, emphasize firm strategies, and are addressed through consumer behavior have come to the fore.

2.1. New Inflation Concepts and Differentiation with the Classical Economic Approach

In recent times, the inflationary environment experienced after the pandemic and global supply chain problems have laid the groundwork for firms to reshape their pricing behaviors. For this reason, studies have begun to appear in the literature on the newly emerging inflation concepts. These different strategies adopted by firms have taken a form that does not fully reflect in numerical inflation data but preserves their profit levels and have indirectly affected the purchasing power of consumers. Within the framework of this information, concepts such as shrinkflation, skimpflation, and greedflation have attracted attention.

Greedflation has emerged from the fusion of the terms 'greed,' meaning the strong urge to constantly obtain more money or food, and 'inflation' (Kruse & Nykvist, 2024: 3). Although the word greedflation is translated into Turkish as açgözlülük enflasyonu, the term greedflasyon has gained more acceptance as a concept. In the economic literature, greedflation is defined as firms increasing prices beyond the inflation rate to raise their profit margins above normal levels, justifying it by claiming rising costs during inflationary periods (Cabral & Nowag, 2023: 1). Shrinkflation emerged from the combination of the words 'shrink,' meaning to reduce or contract, and 'inflation.' As a term, shrinkflation refers to an increase in the unit price paid by consumers due to the reduction in the size or quantity of a product while its price remains the same (Budianto, 2024: 2). Skimpflation has emerged from the combination of the words 'skimp,' meaning to reduce or cut back, and 'inflation.' The Turkish equivalent of skimpflation is nitelik kaybı enflasyonu and it is defined as reducing input costs without increasing the price of a product (Willis, 2023: 28). The reduction in the cost per unit by lowering the quality of the product to maintain profit levels by firms has been explained as a type of inflation from the consumer's perspective.

When the terminological expressions of these concepts are examined, their common point is observed to be their formation according to implementation methods and their connection to the phenomenon of inflation. These three concepts have emerged by differing from the inflation approaches in classical economic theory. According to the classical economic approach, under free market conditions, buyers and sellers with full information interact through supply and demand and make choices rationally. When the emergence patterns of the new inflation concepts are examined, several differences that go beyond the framework drawn by classical economics are observed. Firms, by benefiting from asymmetric information and the condition of consumers who lose their price perception in a high-inflation environment, attempt to preserve or even increase their profit levels with differentiated pricing strategies. Therefore, these concepts point to a situation that cannot be explained by the supply-demand balance provided by the classical pricing method. For this reason, the theoretical basis of the study has been determined according to the framework of behavioral economics, which bases decision-making processes in the economy on the intuitions, biases, and psychological reasons underlying human behavior.

2.2. Behavioral Economics Perspective and Its Relation to New Inflation Concepts

Behavioral economics, which argues that sociological and psychological factors should also be included when examining human economic behavior, emerged as a reaction to the neoclassical economics view of homo economicus (rational man) (Can, 2012: 94). Behavioral economics, whose roots lie in Adam Smith's Theory of Moral Sentiments, was first used in 1951 by George Katona, who is considered the founder, and was later expanded by Kahneman and Thaler, who have recently conducted research in this field, and has been accepted as a new sub-discipline in economics (Tekin & Sökmen Gürçam, 2019: 67). The most significant contributions to the recognition of behavioral economics as a scientific discipline were made by Daniel Kahneman, who won the Nobel Prize in Economics in 2002, and Richard Thaler, who won it in 2017.

Kahneman (2002) tried to build a bridge between economics and psychology. He stated that intuitive judgments and preferences in psychology can be adapted to economic decision-making processes. He claimed that individuals make economic decisions not according to their current wealth, but based on the probabilities of losses and gains. He suggested that individuals tend to avoid making a decision unless the probability of gain is at least twice as high as that of loss when choosing between gain and loss. In the article published by the Royal Swedish Academy (2002), the contributions of Daniel Kahneman, who won the Nobel Prize in Economics, to behavioral economics were included. Kahneman opposed the view that economic decisions are governed by self-interest and rationality and are motivated by monetary incentives. He argued that it is not possible to act with full awareness as assumed in the rationality hypothesis and that less conscious factors also shape individual behavior. These factors are intuitive judgments and preferences. According to Kahneman's view, economic decisions are also influenced by intuitive judgments and preferences. Kahneman argued that decisions made under uncertainty would not be compatible with rationality and that the decisions taken violate the principles of utility maximization.

Thaler (2018), in his Nobel Prize-winning article, pointed to the real-life events he experienced as the starting point of his studies that guided behavioral economics. He compared

these events with human behaviors in economic theory and tried to reveal the inconsistencies. In his research to place the events he experienced on a scientific basis, he examined the study titled Judgment Under Uncertainty: Heuristics and Biases written by Kahneman and Tversky in 1974, and discovered for the first time the connection between his experiences and behavioral economics through this study. The most important inference he made from this study was that biases are at the core of human judgments. He explained this by stating that people can easily recall similar types of events when calculating the probability of an event. Thaler claimed that when people make a judgment about something, they bring similar events from their memory to the surface and use their biases. Thus, he reached the assumption that people make predictable mistakes. With this assumption, he opposed the view proposed by Herbert Simon in 1987, which suggested that people act with bounded rationality and make optimal choices. He claimed that people prefer to make choices based on the probabilities of gains and losses, as in prospect theory, rather than maximizing expected utility. He opposed the view, based on the rational choice model that underpins Gary Becker's studies, which argues that even if consumers do not make rational choices, firms will act rationally. He supported this claim with the example of consumers accepting long contracts without reading them and then facing heavy sanctions when they want to withdraw from the contract. He argued that in this case, firms take advantage of the consumers' lack of information.

Based on this theoretical background, the practices that lead to phenomena such as greedflation, shrinkflation, and skimpflation have been evaluated as non-transparent and misleading strategies of firms that take advantage of consumers' incomplete information about pricing and distortions in price perception. Consumers purchase products that gradually and in very small amounts shrink over time due to reasons such as carelessness or willingness to pay a lower price. They cannot understand that the quality has decreased because they do not have complete information about the production process of the product. During periods of high inflation, they consider the price increase as normal and cannot know what the appropriate level of prices should be. These situations are related to how new inflation concepts, which arise for different reasons, are reflected on consumers. The behavioral economics approach considers these concepts in the distinction of firm strategies (supply side) and consumer behaviors (demand side) and also evaluates their mutual interaction together. The application of strategies targeting consumer psychology while firms shape their pricing policies is in line with the main conclusions of behavioral economics. In this context, greedflation, shrinkflation, and skimpflation can be evaluated not only as emerging through economic decision-making processes but also as strategies involving psychological manipulation.

2.3. New Concepts of Inflation in the Context of the Ethical Dimension and Asymmetric Information

The new inflation concepts open a new door to ethical debates in economics, in addition to firms' cost and pricing strategies. Firms do not communicate the practices of reducing product quantity or lowering product quality to consumers in an open and transparent manner. This situation restricts consumers' decision-making power and provides firms with an advantage based on information asymmetry (Akerlof, 1970: 489). This advantage lays the groundwork for the moral hazard concept to be observed in skimpflation and shrinkflation practices. In the literature, moral hazard has been defined as individuals increasing their expenditures by reduc-

ing care costs through health insurance (Pauly, 1968: 535), or as the misallocation of resources as a result of risks being insured through contracts (Marshall, 1976: 880). Although there are many different approaches to moral hazard, this dimension that emerges as a result of firms' skimpflation and shrinkflation practices is associated with the gain arising from the lack of information. By emphasizing that the moral hazard observed in insurance contracts also occurs in various markets such as capital markets, labor markets, and land markets, it is stated that moral hazard is not limited to a single sector but can spread to others as well (Arnott & Stiglitz, 1990:38). In this study, moral hazard is characterized as firms obtaining higher profits through inflationary practices by exploiting their information advantage.

As a result of skimpflation and shrinkflation practices, divergences emerge between nominal and real inflation. These practices do not directly reflect on price levels and cannot be captured by numerical measurement methods. Bils & Klenow (2001) conducted an empirical study using data from the period 1980–1996 in order to measure the impact of quality improvements on inflation. The results of this study revealed that of the annual 3.7% increase in the quality of goods, 2.2%—which corresponds to 60%—appeared as higher inflation rather than real growth. These findings point to the concept of hidden inflation, which demonstrates that the cost paid per unit by the consumer increases and the real purchasing power decreases.

3. Studies on New Inflation Concepts

Inflation has been a phenomenon that has been continuously studied, as it is a dynamic economic variable that all countries aim to keep under control in order to maintain their economic stability. In our country as well, due to the efforts to combat inflation in many periods, numerous studies have been conducted on inflation. However, greedflation, shrinkflation, and skimpflation have emerged as different dimensions of the inflation problem that appeared in the world during the period that started after Covid-19. Although inflation occupies a large place in the literature, these concepts, which have emerged with the evolution of inflation, have only recently started to enter the literature. The number of studies on these concepts has remained limited.

3.1. Literature on Studies Conducted in the World

The new inflation concepts have been addressed at earlier stages in the world literature compared to the studies in Türkiye and have been examined from a broader perspective. While some of the studies show similarities in general framework, some have addressed different dimensions related to the new inflation concepts. These studies are original due to the fact that they have been conducted in different countries and carry characteristics specific to the country in which the study was carried out. Another important feature of the examined studies is that all of them are of current nature.

3.1.1. Greedflation

Greedflation has been examined separately because it has a different formation and reasons than shrinkflation and skimpflation. The studies in the literature covering the last 5 years on this concept are presented below.

Vinod (2022) analyzed whether there is a relationship between profits and inflation and whether greedflation emerged due to this relationship with an econometric method. According to the results obtained by applying the method to 300 quarters of data corresponding to the last 75 years and a subset of 10 quarters corresponding to the last 2.5 years, it was concluded that high corporate profits only caused inflation in the last 10 quarters. It was stated that the increasing corporate profits in previous years were at a normal level, and the high corporate profits seen in 2021-2022, which is the subject of the study, increased due to greedflation.

Dekimpe & Heerde (2023) attributed the high inflation seen in the world after the pandemic to expansionary monetary policies, supply chain difficulties, commodity-driven cost pressures, and wars seen in various regions of the world. The suppressed demand during the pandemic led to demand-based inflation after this period. Especially during periods of high inflation, retailers may damage their reputations by prolonging the inflationary environment in order to make excessive profits. They do this by increasing prices much more than the inflation rate. This situation leads to greedflation. Consumers whose price perception is distorted expect the price increases to be higher than normal even if inflation decreases. In order to support the claims of greedflation, the sharp increase in the profit rates of the 500 largest companies in the USA was cited as an example. In the same period, unit labor costs increased less than prices and the profit margins of firms. Although wages increased nominally, the increase in corporate profits rose even more because real labor costs decreased. Although greedflation increases short-term profits of retailers, it may lead to losses in the long term. The loss of consumer confidence may cause a loss of customers. In addition, trying to make this situation permanent may lead to government interventions in the free market through price regulations and, accordingly, financial losses.

Glover et al. (2023) investigated the reasons for high inflation from 2021 to 2022. Politicians, policymakers, and experts have cited supply-demand imbalances, supply chain difficulties, and the wage-price spiral as causes of inflation. However, greedflation was also shown as another important reason in the study. Firms claimed that prices increased faster than costs. It was stated that pricing may change over time for different reasons. Some of these are the decrease in consumer price sensitivity or the increase in monopoly power due to a decrease in competition. It was suggested that future expectations also affect pricing. Situations such as marginal costs becoming less important for firms or expecting higher marginal costs in the future will affect pricing. Therefore, firms may follow a pricing policy that increases over time instead of sharp and sudden price increases. In the study, pricing was considered an important variable causing inflation. It was theoretically tried to explain that the pricing of firms in the current period, taking into account the expectations of future marginal costs, turned into inflation.

Hornstein (2023) showed one of the reasons for the inflation rates that started in 2021 and reached the highest levels in recent times by mid-2022 as firms using supply problems as an excuse to raise prices excessively. As a sample sector, he examined the non-financial corporate business sector and stated that their profit shares were not much affected by inflation. He calculated the profit shares of these enterprises using the price-cost margin method and showed that their effect on inflation was quite low. This situation showed that firms acted greedily by citing economic problems and engaged in opportunism to increase their profits. The inflation experienced was not price inflation but greedflation.

Krompas (2023) investigated whether firms in Greece increased their profitability unethically under the cover of cost-based inflation. Against a policy discourse that blamed corporate profits as the reason for price increases, he claimed through an examination of economic data that profits were within the normal range. Therefore, depending on the decrease in real purchasing power caused by inflation, the demand for income support by the government may pave the way for the risk of fueling demand-side inflation. However, instead of reducing prices through competition regulations, implementing policies that increase the country's productivity will eliminate this risk. In the context of the greed hypothesis, households acting with the perception that companies make high profits may constantly demand financial support from the government and exert pressure for wage increases. This may lead to an inflationary cycle starting with a wage-price spiral. Another potential problem that competition regulations may cause is that government controls over profit margins may prevent companies from entering the Greek market.

Agiomirgianakis et al. (2024) conducted a study on the banking system of Greece. The study focused on the increase in net interest income of banks and the reasons for this increase. The European Central Bank started to raise interest rates in July 2022 to suppress inflation and raised it 9 times in a row from 0.0% to 4.5%. Banks operating in Greece rapidly increased their lending interest rates but kept deposit rates quite low. As a result of these practices, banks in Greece increased their net interest margin twice as much as banks in other European Union countries. One of the most important reasons for this situation was the oligarchic structure of the banks in Greece. This oligarchic structure brought high profits to the banks. In this way, the banks increased their revenues by nearly 60% in 2023 compared to 2022. The increase in interest rates also led to a decrease in savings rates. Each of the events that started with the rise of inflation followed each other as links in a chain. Banks saw the rise in interest rates as an opportunity and acted greedily. This behavior of the banks is a kind of greedflation.

Lavoie (2024) stated that the production and agricultural supply chain problems and the increases in energy prices that emerged during the Covid-19 pandemic and the Ukraine War accelerated inflation. He supported his claim theoretically with the post-Keynesian view. According to this view, inflation is basically cost-based and arises due to reasons such as the increase in imported input prices and fluctuations in exchange rates. While economists accepted that inflation increased due to these reasons, they also added that firms, wanting to increase their profits even more, benefited from the inflationary environment and set prices far above costs. This situation was named profit inflation, seller inflation, or greedflation.

Scanlon (2024) examined the interaction between inflation and market power. Based on the assumption that consumers have incomplete information about prices, he claimed that as price level uncertainty increases, firms increase prices to increase profits. He explained this by the difficulty consumers have in distinguishing relative prices and the complication of decision-making processes. He stated that the volatility of price levels hides price signals. This led to demand becoming more inelastic and firms increasing their pricing power and raising their profit margins. Firms took advantage of this situation and benefited from high profit margins. However, it will not be possible for some firms to increase their prices at a lower level in contrast to this situation. Because the price level pulled to a certain level by the majority in the market will be against the firms keeping their prices lower. This can be explained by the deterioration of consumer price perception in a high inflation environment and the possibility of trust issues against the products of firms selling below the prices set by the majority in the market.

Taylor et al. (2024) investigated the reasons for the increase in food prices in Canada in response to rising prices worldwide in 2022. The increase in profit rates, the decrease in transparency, and the increase in costs increased the doubts of consumers. In order to understand the reasons for these changes in consumer perception, an analysis was conducted using data obtained from consumers, sectors, and institutional observers. According to the findings, it was determined that markets priced well above food inflation. Accordingly, it was stated that markets achieved excessive profits by increasing their gross profits well above normal levels with greedflation practices. Although it is difficult to define and frame excessive profit, it was suggested that a boundary can be drawn by examining certain time intervals and based on changes in obtained profits. Similarly, Stephens et al. (2025) investigated the rising food prices in Canada through retail market data and tried to determine whether there were greedflation practices. In the study conducted for the 2018-2023 period, prices obtained from 223 farmers' market vendors were analyzed. According to the findings of the study, during the relevant period, the prices of local food products increased less compared to the prices in markets. Strong companies used inflation as an excuse to increase food prices and raised their profit rates to very high levels. This situation was interpreted as greedflation. Both studies reached similar results through different methods and determined the existence of greedflation.

Koppenberg et al. (2025) analyzed whether food and beverage producers operating in the European Union took the opportunity to raise output prices well above marginal costs due to the increase in raw material prices. He estimated the production function for price determination based on marginal costs of a large sample group of nearly 90,000 for the 2013-2022 period. According to the results obtained, it was claimed that firms did not raise prices excessively through greedflation. This claim was supported by the fact that food prices decreased despite the increase in agricultural product prices in 2022. Another important claim of the study was that there was no need for competition-enhancing policies to slow down the price increases in the food and beverage sector. In addition, the decrease in the rate of price increase during the period when input prices increased was explained by the fact that part of the input price increases was covered by the firms. According to these results, although there were no findings of greedflation, it is necessary to investigate whether there are shrinkflation and skimpflation practices by considering the changes in the quality and quantity of the products produced by these firms and the changes in their prices in response to these changes.

3.1.2. Shrinkflation and Skimpflation

Shrinkflation and skimpflation, although similar in their emergence, differ in both implementation and the changes experienced by the products. Since these two concepts are generally examined together in the literature, they are presented together below.

Payne (2019) examined the size changes of goods in the basket of goods used to calculate the consumer price index in the United Kingdom. In the study on changes between 2015 and 2017, it was found that the quantity of 206 products decreased while the quantity of 79 products increased. Most of the products with quantity changes were food products. Consumers, despite the prices of the products remaining the same, experienced a form of inflation by purchasing less. This inflation did not arise directly from price increases but from the impact on purchasing power, which constitutes shrinkflation. While consumers pay more for a product when prices rise with inflation, here, they purchased a smaller amount of the product for the same price.

Singhal & Gupta (2023) examined data on fast-moving consumer goods and addressed the downsizing practices in these products. There were reductions in either the quantity or size per package of the examined products. The study noted that shrinkage practices have become widespread and normalized for companies. Instead of covering rising costs by increasing prices, firms have begun to make small reductions in product quantity or size. The key advantage of this practice is that it is difficult for consumers to notice. It will not be possible for the continuous downsizing of products to become permanent. At some point, firms will have to increase prices without shrinking the product, as initially undetectable reductions will eventually reach a level noticeable by customers.

Akinwale & Mbewu (2024) investigated whether there is a relationship between shrinkflation and personality among young adults living in Lagos, Nigeria. The study examined how different dimensions of consumer personality play a role in how consumers perceive changes in daily consumption products. Demographic factors such as age, gender, and current employment status were also evaluated. According to the findings, although there was no significant relationship between personality dimension and shrinkage perception, the perception of shrinkage was found across all demographic groups.

Bhat et al. (2024) evaluated the fluctuation effects of inflation and shrinkflation on growth in the BIPS (Bangladesh, India, Pakistan, Sri Lanka) countries. Dynamic panel data analysis and causality tests were used. A shrinkflation variable was generated from the inflation rate function. It was found that shrinkflation had negative effects on growth parallel to inflation. The economic uncertainty during the relevant period was found to originate partly from inflation and partly from shrinkflation.

Chalioi & Serfes (2024) stated that companies resort to shrinkage practices by reducing product quantities or sizes instead of raising prices to protect profit margins in response to rising costs. In less competitive markets, due to insufficient consumer price perception, the price paid per unit increased. Shrinkage practices harm social welfare. The continuation of consumers' lack of perception leads to further shrinkage in products. Instead of intervening in the market and banning these practices, the need for regulations ensuring full transparency by companies and informing consumers was advocated.

Claus & Pandelaere (2024) conducted research on the use of the left-digit effect in shrinkage practices. This effect, appealing to price perception and making products more attractive to consumers, relates to people reading numbers from left to right and assigning greater importance to digits on the left. According to the left-digit effect, a product priced at 199 units appears more attractive than one priced at 200 units; however, in shrinkage practices, this creates the opposite perception. For consumers, a product decreasing from 400 grams to 395 grams creates a much stronger perception of shrinkage compared to a decrease from 450 grams to 445 grams. Presenting products with shrinkage together with a price discount will break the negative perception that may arise from shrinkflation. This will both prevent damage to the company's image and offer a lower-quantity, lower-priced option for consumers who do not want to pay high prices in an inflationary environment.

Evangelidis (2024) investigated consumers' perceptions of shrinkage and quality loss practices. Consumers viewed price increases in response to rising costs as the most reasonable option, while reducing quantity without increasing price was seen as less reasonable. Consum-

ers found the decrease in product quality without a price change to be almost entirely unacceptable. Consumers reacted more strongly to shrinkage and quality loss practices conducted without their knowledge than to transparent practices. Furthermore, consumers responded less to external changes like packaging than to intrinsic changes in product quality. Kalaitzandonakes et al. (2024) conducted a similar study for consumers living in the USA. Survey results from a specific sample group showed similar findings. When asked which pricing strategy was the best option in the face of rising costs, consumers were offered the choices of raising prices, keeping the price constant but reducing product quantity or size, or keeping the price constant but reducing product quality. Consumers selected price increases as the most appropriate option and quality reduction as the least acceptable. The option of reducing product quantity while maintaining the price was determined to be an average choice. As seen in the findings of both studies, general consumer behavior has shown similarities.

Greaves & Springfield (2024) measured consumer knowledge about shrinkflation and examined the impact of big data on shrinkage practices. The recent increase in such practices has made consumers more informed. In an example study shared in the paper, nearly 60% of consumers noticed that a product they previously purchased had decreased in quantity without a price change. Only 19% had never noticed this. There was also a significant increase in the number of searches for the term shrinkflation in search engines between 2021 and 2022. This indicates that consumers have become more informed about changes in products due to inflation. This practice may cause a loss of trust among consumers and damage companies' reputations. Consumers may react more strongly to such covert practices learned afterward than to price increases.

Jansen & Kassinger (2024) analyzed shrinkage practices observed in various product categories in retail markets in the USA using ten years of retail scanner data. Shrinkage practices, seen not only among producers but also among retailers, were applied more as reductions in product size or quantity than increases. This increased the price paid per unit by the consumer. Additionally, it was found that consumers are more sensitive to price changes than to size changes. Shrinkage practices served as a way out for retailers facing cost pressures in an inflationary environment but harmed consumers who focused on price changes in a high-inflation environment.

Milan & Singh (2024) examined the relationship between shrinkflation and sustainability in the food packaging sector. The impact of financial concerns, cost-cutting measures, and changes in consumer preferences that underpin shrinkage practices was investigated. The study also considered how these practices affect a firm's reputation in the eyes of consumers. Another aspect addressed was how shrinkflation affects sustainability by highlighting how resource consumption, waste production, and carbon emissions can be reduced. The reasons driving companies to shrinkage practices were listed as inflation, rising costs, consumer perception, profit maximization, competitive pressure, and marketing strategy. Fundamentally, these reasons stem from companies avoiding alienating consumers through continuous price increases in a high-inflation environment. Companies often overlook the reputational damage when consumers notice such practices. A consumer-centric approach and partial sacrifice of short-term profits will reduce the risk to long-term profits and help avoid changes in consumer preferences caused by diminished trust.

3.2. Literature on Studies Conducted in Türkiye

Studies on the new inflation concepts in our country are limited. These studies have been conducted within the last 3-4 years. By examining these studies, comparisons have been made with the studies in the global literature. Through the comparison of studies conducted in our country and those in the global literature, similarities and differences have been tried to be revealed.

Yergin et al. (2021) attempted to convey that the calculated inflation and the inflation felt by society are different while addressing the phenomenon of inflation. It was stated that in high inflation environments, producers may tend to reduce the quality and quantity of products due to increasing costs. This situation is related to producers' concern that rapidly rising prices, caused by prolonged high inflation, may lead to excessive consumer reactions. In long-lasting high inflation environments, consumers' price-focused product preferences may lead them to not notice changes in product quality and quantity made by producers. Since inflation is calculated based on price changes, these differences in quality and quantity of products will not be reflected. Periods during which high inflation continues and is prolonged will lay the ground for the increase of such practices. While consumers pay the same price for the products they purchase, the decrease in the quality and quantity of the product reveals a different dimension of inflation. Although it may seem that prices are not rising, the reduction in the quantity and quality of products will lead consumers to buy a smaller amount or lower quality product for the same price. Accordingly, consumers will be exposed to a different dimension of inflation through quality and quantity loss.

Yıldız (2022) investigated whether the wage-price spiral has an effect on inflation through the ARDL bounds testing approach. The theoretical aspect of the wage-price spiral was explained by the triggering of inflation through a positive aggregate demand shock or a negative supply shock. The demand-pull inflation triggered by an aggregate demand shock will start the wage-price spiral as workers attempt to protect their real wages and producers, aiming to maintain their profit levels against increasing wages, raise prices again. In the other scenario, the cost-push inflation triggered by a negative supply shock will initiate the wage-price spiral through firms raising prices to maintain or increase their profit levels, and workers wanting to preserve or increase their real purchasing power. The common point of the two scenarios explaining the wage-price spiral is inflationary expectations. In both cases, workers and firms aim to preserve their real wage or profit levels based on inflationary expectations. Looking at the explanation of the wage-price spiral through inflationary expectations from a different angle, it can be seen that inflationary expectations have turned into greedflation. In periods of prolonged high inflation, the rapid increase in wages and prices caused by the wage-price spiral may lead firms and workers, who act with inflationary expectations, to act with a desire to earn more over time. The rapid progress of the wage-price spiral will lay the ground for greedflation.

Erdoğan & Gürbüz (2023) drew attention to how marketing strategies are affected in a high inflation environment. Firms may be concerned that rapidly rising prices will lead consumers to reduce demand, turn to substitute goods or competitor firm products. To avoid reducing profit margins without changing prices, practices such as shrinkage or quality loss may be used to preserve the perception that the price has not changed in the eyes of the consumer. Among these practices, reducing the gram weight of the product, shrinking the packaging, or

decreasing the amount leads to shrinkflation. On the other hand, reducing the quantity and quality of inputs used to reduce costs, or reducing the number of employees, leads to skimpflation. These practices turn into situations that violate marketing ethics, consumer trust, and consumer rights. With these practices, firms aim to protect strategies fundamentally based on not losing consumers. Consumers find it more difficult to perceive the reduction in product quantity or quality than changes in price. Even if consumers perceive the change in quantity or quality, firms estimate that they will not mind buying a smaller amount or lower quality product at the same price. This shows that consumers care more about the change in purchasing power than the change in the quantity and quality of the product they buy during high inflation periods.

Gökbulut (2024) conducted a theoretical study on the taxation of windfall profits. Applications in the European Union regarding the taxation of windfall profits were addressed. Due to the Covid-19 pandemic and the Russia-Ukraine war, rising energy prices increased input costs especially for firms producing petroleum and electricity. This led to an increase in household energy expenditures. Consequently, the profit levels of firms realized much higher than expected. One of the reasons for the profit increases exceeding expectations was shown to be firms exploiting crisis environments and raising prices far above normal levels. This sharp rise in prices has been described as greedflation. The European Union introduced some measures to tax windfall profits, and these measures were supported by all European states. Although the European Union considers the taxation of windfall profits as a temporary measure, there are predictions about its expansion. The European Central Bank's continuous increase in interest rates since 2022 has paved the way for banks to raise lending interest rates. However, banks not raising the interest rates they offer to savers as much as the borrowing rates led to expectations of windfall profits in the banking sector. Taxing windfall profits will cause some problems in every sector. The state's intervention in profits by taxation on the grounds that they are too high and firms exploiting crisis situations such as wars or pandemics to obtain excessive profits reflects a dilemma for free markets.

Taş & Boyacıoğlu (2024) conducted a survey study to measure the awareness level of consumers regarding shrinkflation and to understand how shrinkflation affects consumers' economic decisions. In the survey, consumers' perceptions of shrinkflation were tried to be measured by classifying certain products that they use in daily life and that have been subjected to shrinkage. It was determined that the level of perception of consumers varied by product group and that they continued to purchase these products for different reasons.

4. Purpose, Scope and Method

In this study, it is aimed to determine in which aspects the concepts of greedflation, shrinkflation, and skimpflation overlap with the theoretical perspective of behavioral economics. Depending on the areas and ways of application of these concepts, their effects on the production and purchasing decisions of firms and consumers have been examined. Moreover, by analyzing how these concepts guide consumer purchasing behavior and firms' sales and marketing strategies, it has been tried to determine to what extent they differ from classical inflation approaches.

Since the origins of the concepts addressed in the research date back only to the past 5 years, the scope of the literature in the study corresponds to this time frame. The theoretical

scope of the study covers the last 40-year period, during which behavioral economics began to develop long after its initial emergence.

In the study, literature review and agent-based theoretical modeling methods were employed. The literature review was conducted both on a theoretical basis and within a conceptual framework. Efforts were made to establish relationships between the fundamental assumptions of behavioral economics and these concepts. Due to the fact that the examined concepts are new in the literature, that their relationship with other economic variables has only been partially identified, and that they cannot be fully included as variables in econometric models, an economic analysis was not conducted under current conditions. Through the agent-based approach, attempts were made to establish a relationship between the assumptions of behavioral economics and the new inflation concepts by transferring variables into mathematical formulas. Another factor behind the choice of an agent-based approach was the inapplicability of empirical analyses due to the lack of numerical and measurable data and the fact that the concepts addressed in the study arise from the behaviors of firms and consumers. The firm and consumer behaviors that have been effective in the emergence of the new inflation concepts were associated with behavioral economics, and the underlying reasons for these behaviors were examined.

4.1. Agent-Based Modeling

The foundation of the agent-based modeling technique lies in cellular automata, developed by Von Neumann (1951) while studying self-replication of systems, which convert behaviors into algorithms in a computerized simulation environment (Schinckus, 2019: 171). With significant contributions from economists at the Santa Fe Institute, this technique evolved through the application of genetic algorithms in economics, and modeling attempts such as simple barter economies, artificial adaptive agents instead of classical rational agents, and artificial stock markets have been carried out (Er et al., 2005: 82). In this model, adapted to economics as agent-based computational economics, roles such as individuals (producers, consumers) and social groups (families, firms) are assigned to agents, and how they respond under certain conditions is tried to be measured (Keleş & Eren, 2014: 208).

Through the agent-based modeling approach, the reflections of human behaviors outside the patterns of classical economics on economic decision-making processes are addressed. In the literature, there are studies that associate this approach with behavioral economics. Magliocca et al. (2011), in their research on housing and land markets, identified three agents as developers, farmers, and consumers, and created a model for the conversion of agricultural lands into housing areas based on the actions of these agents over time. Vermeulen & Pyka (2016), within the theoretical framework of behavioral economics, tried to measure agent behavior by addressing different dimensions of decision-making under uncertainty. Kano et al. (2021), in an approach that addresses economic activities related to the COVID-19 pandemic, used agent-based modeling to observe the trade-off between health and economic damage. In this study, the idea of a theoretical model based on the agent-based approach is intended to be presented.

Agent-based modeling has significant advantages, such as the ability to include multiple agents in the model, freedom in determining the rules, the ability to set the rationality level of

agents, and its adaptability to different approaches (Bazgahndi, 2012: 115). Agent-based modeling has been preferred due to these advantages. In contrast to the certain patterns of classical economics, the behavioral economics approach, which is based on human behavior, aligns with the flexible structure of agent-based modeling.

4.2. Establishment of the Theoretical Model

With agent-based modeling, two agents were defined: consumer and firm. The characteristics of these agents were considered based on the theoretical framework of behavioral economics. The consumer agent aims to maximize utility under the assumptions of behavioral economics, while the firm agent aims to maximize or preserve profit. Consumers are agents who possess a certain perception of inflation, are price-sensitive, act with bounded rationality, and operate under asymmetric information. Firms are agents who apply pricing strategies through greedflation, shrinkflation, and skimpflation practices, placing inflation at the core of these strategies and being more informed than consumers. Based on these features, the utility function for the consumer agent is shown in equation (1), and the profit function for the firm agent is shown in equation (2):

$$U_c = f(q, P, \mu, \pi, \lambda, \delta) \quad (1)$$

U_c : consumer's utility level, q : quantity of the good, π : inflation perception, P : price of the good, μ : price sensitivity, δ : level of rationality, λ : level of asymmetric information

$$\Theta = f(c, q, P, g, \phi, \hat{s}) = R(q, P, g, \phi, \hat{s}) - C(c, q) \quad (2)$$

Θ : firm's profit, R : revenue, C : cost, c : unit cost, q : quantity of the good, P : price of the good, g : greedflation effect, ϕ : shrinkflation effect, $\hat{s}$: skimpflation effect

These functional definitions of consumer and firm agents provide an estimation of what their decision-making behavior depends on. This estimation is addressed within the framework of behavioral economics, differing from the assumptions of classical economics. Determining the role of variables included in the model is essential to understanding their impact on utility or profit maximization when constructing behavioral models of consumer and firm agents. The primary references for the placement of variables are Kahneman & Tversky (1979), Tversky & Kahneman (1992), Foxall et al. (2004), and Rotemberg (2005).

Kahneman & Tversky (1979) developed Prospect Theory. They stated that consumers evaluate utility based on probabilities of losses and gains. In decision-making processes, they behave in a way to reduce the risk of loss by evaluating low probabilities beyond their mathematical magnitude and are more inclined to select high-probability gains. They emphasized that the expected utility theory, which aligns with the classical approach, is inconsistent with the behavior of economic agents and that these agents resort to behavioral decision-making in their choices. While forming the utility function, they excluded zero from the probabilities and represented parameters in the form of $(1-x)$. The total value of all probabilities was set to 1 ($p_1 + p_2 + \dots + p_n = 1$). Another point is that, when definite amounts of gain or loss are guaranteed, these parts are treated as constants and excluded from probability evaluation, while the remaining loss or gain probabilities are assessed separately. Tversky and Kahneman (1992) expanded Prospect Theory cumulatively, attempting to address its shortcomings. By expressing a given

probability (p) and its complementary (1-p), they increased the consistency of results ordered by probability. This is represented by the formula in equation (3):

$$w-(p) = 1 - w + (1 - p) \quad (3)$$

w: loss, p: probability, w+: gain

According to the findings in Foxall et al. (2004), consumers do not evaluate product prices alone while maximizing utility, but rather choose among known brands, selecting the cheapest one. Consumers tend to choose a product whose price is close to the average of the brands they prefer. Thus, they choose one of the desired brands while also picking what they perceive as the most affordable. Another notable behavior is that consumers sometimes purchase different brands of the same product in the same shopping experience, showing that they do not strictly limit their choices. Contrary to the common view in the literature, price has a greater effect on consumer preferences. The influence of differentiation factors such as advertising and brand quality is relatively lower compared to promotions, campaigns, and discounts.

Rotemberg (2005) addressed consumers' reactions to price changes and how firms adjust pricing strategies accordingly. He argued that firms consider not only economic reasons such as competition and cost but also consumers' responses to price increases in their pricing strategies. He claimed that consumers' price perception is shaped around whether the price is perceived as fair and that price increases are considered acceptable when tied to economic crises or high inflation. Another attitude of consumers toward price increases relates to the conditions under which the increase occurs. According to this view, consumers find price increases due to product innovations more reasonable than those without changes in packaging or quantity. Dislike of price increases has become one of the most widely held assumptions about pricing strategies.

In this study, it is aimed to determine the placement of variables in the consumer and firm agents' utility (equation 1) and profit (equation 2) maximization models. The parametric representation formats in Prospect Theory and Cumulative Prospect Theory by Kahneman & Tversky (1979), the inferences on firms' pricing strategies by Rotemberg (2005), and the findings of Foxall et al. (2004) regarding the role of price in product selection form the basis of these models. The utility maximization model and profit maximization model are shown in equations (4) and (5):

$$U_c = q^a \cdot e^{-bP} \cdot (1 - \mu)^c \cdot (1 - \pi)^d \cdot (1 - \lambda)^f \cdot (1 - \delta)^h \quad (4)$$

U_c: consumer's utility level, q: quantity of the good, P: price of the good, μ : price sensitivity, π : inflation perception, λ : level of asymmetric information, δ : level of rationality

The exponential values shown for the respective parameters in the model represent sensitivity coefficients indicating the relationship between utility and the associated variables. Garderen (1997), in his study, emphasized that exponential models, especially those based on curved exponential structures, are widely used in econometric applications due to advantages such as representing continuous increase or decrease. The use of exponential-parameter functions in various economic modeling areas supports this approach. Koffarnus et al. (2015), based on the exponential pricing model proposed by Hursh & Silberberg (2008), attempted to develop

a behavioral demand model. Exponential functions were used due to their ability to account for zero consumption values, increase the reliability of empirical results, and accurately estimate parameters. The structure of the model is based on these studies in the literature.

$$\Theta = (P^* q) - (c \cdot q) \quad (5)$$

Θ : firm's profit, c : unit cost, q : quantity of the good, P^* : firm-structured price

Although the firm's profit function resembles the classical profit function, P^* is a price structured through the firm's pricing strategies, differing from the market price. P^* is expressed in equation (6):

$$P^* = P \cdot (1 + g + \phi + \hat{s}) \quad (6)$$

P : price of the good, g : greedflation effect, ϕ : shrinkflation effect, $\hat{s}$: skimpflation effect

This new price leads to an increase in the firm's profit level. These are pricing strategies that raise the price above the market price. When P^* is included in the firm agent's profit function in its extended form, the equation is shown in (7):

$$\Theta = [P \cdot (1 + g + \phi + \hat{s}) \cdot q] - (c \cdot q) \quad (7)$$

The main reason for modeling the consumer and firm agents differently is that the utility level the consumer aims to maximize has qualitative features, whereas the profit level the firm agent aims to maximize has measurable quantitative features.

5. Discussion

Based on the reviewed literature and theoretical perspective, several conclusions have been reached. The economic decisions made by firms and consumers during periods of high inflation align with the theoretical explanations of behavioral economics. The pricing policies adopted by firms—due to cost increases, marketing strategies, or the desire to maintain profit margins—have created a basis for the emergence of greedflation, shrinkflation, and skimpflation.

Both firms and consumers have made economic decisions in inflationary environments based on probabilities of gain and loss. Firms, perceiving higher probabilities of increasing profits in high inflation environments, have raised prices well above normal. Consumers, due to deficient price perception, a focus on purchasing power over products, and the belief that prices would continue to rise, have been compelled to accept these prices. Intuitive behaviors played a role in consumers' attitudes toward prices. The thought that prices would continue to increase indefinitely has overshadowed price inquiry, leading consumers to prioritize protecting their purchasing power. Thus, consumers have made decisions under uncertainty and have not acted in accordance with utility maximization principles.

Consumers have been less sensitive to changes in product quality or quantity implemented by firms than to price changes. The fact that consumers' inflation-related memories are more developed concerning past price changes than about shrinkflation or skimpflation has caused them to focus on price over product alterations. This reflects the concept of decision-making based on biased judgments, as emphasized in behavioral economics.

In the theoretical modeling framework, factors influencing the economic decision-making processes of consumer and firm agents have been attempted to be incorporated into the models. These models were developed on a theoretical basis. The reason for this is the behavioral and psychological nature of variables related to consumers and the lack of numerical reflections of firm pricing strategies that lead to inflationary consequences. The most significant factor contributing to this is the problem of asymmetric information. Since firms are more informed than consumers, they can implement implicit pricing strategies. Cory Jr. (2006) and Hsun Hsu et al. (2018) also attempted behavioral economics-based modeling in their studies and addressed different aspects of consumers' economic decision-making processes. The model established in this study within the theoretical ground of behavioral economics is similar in direction to these studies.

6. Conclusion

The neoclassical approach, which has been the most influential economic thought in the last century, has at times been criticized due to crises, the effects of globalization, and national or international economic problems. Along with these criticisms, new ideas opposing the assumptions of the neoclassical model have emerged. Behavioral economics has emphasized the shortcomings of the neoclassical model's assumptions of rationality and utility maximization that evaluate humans within fixed frameworks. It has argued that intuition and biases can play a role in the behavior of economic decision-makers.

Greedflation, shrinkflation, and skimpflation have emerged as new concepts resulting from the evolution of inflation. Some of the most significant factors in the emergence of these concepts were the COVID-19 pandemic and subsequent global conflicts. Although the global economy is no stranger to crises and economic issues, the long-term effects of the pandemic led both firms and consumers to behave differently in their economic decisions. Supply chain problems, strongly emphasized by firms, emerged as a consequence of pandemic lockdowns, and the subsequent resurgence of suppressed demand caused inflation rates to increase unexpectedly worldwide. This inflation was particularly evident in food products. Constantly rising prices due to inflation led firms, driven by the tendency to preserve profit margins, to adopt various practices. Firms wishing to benefit from rising inflation increased prices faster than the inflation rate. Profit margins in many sectors multiplied compared to previous periods. As the price increases extended over a longer period than expected, some firms resorted to inflation-like practices to preserve profit margins. Firms that reduced product quality or quantity while keeping prices stable attempted to maintain profitability.

Consumers, the other group facing inflation, have made purchasing decisions driven by instincts to preserve purchasing power, a lack of price perception, and concerns induced by inflationary environments. For consumers, the inflation experienced was not a result of changes in product prices but of changes in quantity or quality. This has revealed a different form of inflation. Consumers were exposed to inflation not through a direct price increase but through the increase in the price paid per unit.

In the theoretical modeling, the factors affecting the economic decision-making processes of both consumers and firms were expressed parametrically. This modeling aimed to concretize how the behavior of consumers and firms in seeking utility and profit maximization

differs from classical economic approaches. The divergence of theoretical modeling in the study from empirical methods is based on the absence of an accumulated numerical data set due to the novelty of the concepts and the inability to directly measure consumer and firm behavior quantitatively.

Although such practices by firms stem from reasons such as preserving profitability and marketing strategies, they will be a temporary solution. These solutions, beneficial in the short term, will ultimately contradict firms' interests in the long term. As consumers become more informed over time, firms' reputations will be damaged. This will undermine consumers' trust in firms. Measures to prevent such practices that harm consumer welfare may result in market intervention, potentially leading both domestic and foreign investors to withdraw. Instead of regulatory measures, incentives can be offered to ensure that firms' pricing policies become more moderate. This would preserve both market functioning and firm-consumer relations.

This study provides a conceptual framework aimed at explaining the behavioral foundations of newly emerging inflation concepts through theoretical modeling. In this respect, the study aims to contribute to future empirical research by establishing a conceptual basis for examining the measurable dimensions of these concepts. Furthermore, the acquisition of empirical data requires that these concepts be reflected in economic indicators over time, that consumer behaviors be systematically observed, and that firms' pricing strategies become traceable through quantitative data.

Declaration of Contributions by Researchers

The authors have contributed equally to the study.

Declaration of Conflict of Interest

There is no conflict of interest amongst the authors of this article.

Statement on the Use of Artificial Intelligence

In this study, artificial intelligence tools were used to assist with translation and grammatical corrections. The study does not contain any sentences generated by artificial intelligence

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