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The Impact of Structural and Behavioral Shocks on Market Power in Iran's Food Industry

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Abstract

This study investigates the effects of structural and behavioral shocks on market power across 17 four-digit ISIC subsectors of Iran's food industry from 2002 to 2022. We employ a Panel Structural Vector Autoregression (PSVAR) model within the Structure-Conduct-Performance (SCP) framework, enabling a dynamic analysis of the interactions between structural and behavioral shocks. The variables examined include the exchange rate, energy costs, market concentration, value added, advertising expenditures, and intermediate input costs. Variance decomposition results reveal that structural and cost-related factors—intermediate input costs, value added, energy, and the exchange rate—account for over 80% of the variation in market power (Lerner index). Intermediate input costs emerge as the most significant negative driver of market power. Market concentration exerts a positive effect, while value added has a reinforcing effect through innovation. In contrast, behavioral factors such as advertising play a purely marginal role, contributing less than 1%. Owing to institutional constraints and consumer price sensitivity, these factors fail to significantly influence firms' pricing power. These findings confirm that market power in Iran's food industry is primarily shaped by cost structure, industrial concentration, and macroeconomic policies rather than by firms' behavioral strategies. Accordingly, given the key role of structural and cost factors, policy recommendations include managing production costs, fostering innovation and value added, mitigating exchange rate risk, regulating market structure, rethinking advertising strategies, and strengthening market regulation policies.

Keywords: Iran, Food industries, Lerner index, Market power, Panel SVAR, SCP framework

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Introduction

The food industry is a cornerstone of economic stability and social welfare, playing a vital role in ensuring food security, generating employment, and contributing to gross domestic product. Beyond meeting nutritional and public health needs, this industry is particularly vulnerable to external shocks—such as climate change and geopolitical tensions—making resilience and innovation essential (Wang *et al.*, 2025). Technological advances, including mechanization and biotechnology, have enhanced productivity and sustainability while simultaneously shaping market power dynamics (Wang *et al.*, 2025).

Iran's food industry, however, faces considerable structural and external challenges. High market concentration in certain subsectors—such as bread and beverage production—coupled with volatile exchange rates, rising energy costs (despite subsidies), and heavy reliance on imported intermediate inputs, has undermined pricing stability and weakened firm competitiveness (Khodadkashi *et al.*, 2018; Akhani *et al.*, 2024). These conditions distort market power and may lead to higher consumer prices, lower productivity, and increased food insecurity.

Market power refers to a firm's ability to set prices above marginal cost or to pressure suppliers into accepting lower prices. The Structure-Conduct-Performance (SCP) framework serves as a key theoretical lens, linking market structure (e.g., concentration, entry barriers) to firm conduct (e.g., pricing strategies, advertising), and ultimately to market performance (e.g., profitability, productivity). The core premise is that market structure shapes conduct, which in turn determines performance (Mydland *et al.*, 2022).

Previous research on market power in the food industry falls broadly into two streams. International studies have largely emphasized behavioral factors such as advertising and branding (Apelbaum, 1999; Tripathy, 2025), the relationship between innovation, productivity, and markups (Jaumandreu & Lopez, 2024; Wang *et al.*, 2025), and the role of market structure and globalization in shaping profit margins (Syverson, 2019). Domestic Iranian studies, in contrast, have focused on foreign competition (Shahiki Tash & Ettazii, 2012), measuring monopoly power and its dispersion across the industry (Khodadkashi *et al.*, 2015, Khodadkashi *et al.*, 2018; Heydari, 2019), and the effects of macroeconomic policies such as energy subsidies (Akhani *et al.*, 2024). While valuable, these studies leave a clear gap: first, a lack of dynamic, shock-based analysis that captures the causal and intertemporal interactions between structural factors (costs, concentration) and behavioral factors (advertising) within the SCP framework. Second, few studies have adopted a structural, dynamic modeling approach tailored to the unique features of Iran's economy—namely, energy subsidies, exchange rate volatility, and a concentrated market structure.

This study aims to fill that gap through both methodological and substantive innovation. Methodologically, it introduces, for the first time in the Iranian context, a Panel Structural Vector Autoregression (PSVAR) model. This approach enables a dynamic, simultaneous analysis of shocks to key variables, identification of causal relationships, separation of short- from long-run effects, and accounting for firm heterogeneity. Substantively, by focusing on 17 subsectors of Iran's food industry and integrating structural shocks (exchange rate, energy costs, input costs, market concentration) with behavioral shocks (advertising expenditures and innovative value added) into a unified framework, this study asks: what is the relative contribution of each factor to shaping market power under Iran's specific economic conditions? Grounded in the SCP framework and inspired by Mydland *et al.* (2022), this research analyzes the dynamics of market power in Iran's food industry. Yet, through its methodological innovation—employing the PSVAR model and focusing on shock transmission—it moves beyond prior work and offers fresh insights for industrial policy and firm strategy in this critical sector.

Analyzing market power not only clarifies competitive dynamics and their impact on pricing and quality but also supports policies designed to promote fair competition and protect consumer welfare.

The research questions are as follows: How do shocks to market power in Iran's food industry operate within the SCP framework? Do the effects of these shocks vary across subsectors and over time? What are the policy implications of these findings?

The remainder of the paper is structured into four sections. The Materials and Methods section reviews the relevant literature, data sources, and empirical strategy. The third section presents the results and discussion. The fourth section concludes and offers policy recommendations.

Materials and Methods

Economic theory suggests that economies benefit from competition among firms. A lack of competition often results in prices above the marginal cost of production, meaning consumers pay more than the incremental cost of supplying a product. Ideally, society would like to minimize such deadweight losses. Perfect competition—even if rarely attainable in practice—where prices equal marginal costs ($P = MC$), serves as a normative benchmark for well-functioning markets. The problem arises when producers exercise pricing power, resulting in $P > MC$. One might initially suspect that high output prices reflect high production costs, such as elevated wages (Mydland *et al.*, 2022).

Recent evidence, however, indicates that markups have increased over recent decades, both in Europe (Weche & Wambach, 2021) and in the United States (De Loecker, Eeckhout, & Unger, 2020). Markups are a key indicator of market power and deviation from perfect competition. In theory, under competitive conditions, markups should erode and converge toward zero in the long run. In practice, however, real-world markets often exhibit persistent positive markups, signaling the exercise of market power and associated welfare losses. Consequently, identifying the determinants of markups is of paramount importance.

The baseline model of this study draws on Kumbhakar *et al.* (2012) and Mydland *et al.* (2022), but extends their work by incorporating firm heterogeneity and a richer set of determinants—particularly shocks specific to the Iranian economy—thereby offering a more precise, context-sensitive analysis of market power in Iran's food industry.

Efficient production technology is characterized by a standard production function $Y = f(X, T)$, or more generally a transformation function $F(Y, X, T) = 1$, where Y denotes output, X is a vector of inputs, and T is a shifter of the production function, distinct from X. In practice, T is often replaced with a time trend. By duality, all features of the production technology captured by $Y = f(X, T)$ can be uniquely represented by a minimum total cost function $C(W, Y, T)$, where C is minimum total cost and W is the vector of input prices. Hence, all properties of the production function can be derived from the cost function, or conversely, cost function properties can be recovered from the production function. Importantly, these approaches differ in their data requirements: estimating the cost function requires information on input prices, whereas estimating the production function does not.

When product markets are competitive (an assumption maintained in deriving the cost function), the product price equals marginal cost (MC), and the markup component is zero. Consequently, if $P > MC$, a positive markup is said to exist. To compute MC, we first estimate a cost function, then derive MC from it. The firm-level markup is then calculated as $(P - MC)/MC$. A positive markup indicates non-competitive behavior in the product market. This approach follows De Loecker & Warzynski (2012), although De Loecker *et al.* (2020) raised concerns, noting that prices may also be high due to large fixed costs.

Assuming that $P > MC = \partial C/\partial Y$, it follows that:

$$\frac{PY}{C} > \frac{MC \cdot Y}{C} = \left(\frac{\partial C}{\partial Y}\right)\left(\frac{Y}{C}\right) = \frac{\partial \ln C}{\partial \ln Y}, \quad (1)$$

where PY/C is the share of revenue in total cost. Inequality (1) can be turned into an equality by introducing a non-negative one-sided term u:

$$\frac{PY}{C} = \frac{\partial \ln C}{\partial \ln Y} + u \Longrightarrow RS = E_{cy} + u, u \geq 0, \quad (2)$$

Where $RS = PY/C$ and E_{cy} is the cost elasticity. In equation (2), u represents the markup. However, u cannot be directly recovered from the data because $\partial \ln C/\partial \ln Y$ must be obtained from an estimated cost function. Moreover, the revenue share may be contaminated by unobserved factors. We assume that such noise is captured by a symmetric two-sided error term ν. Including ν in (2) renders the equation analogous to a stochastic frontier (SF) specification. Thus, we draw on the efficiency literature and employ the SF approach to estimate markups at the observation level.

Estimating a cost function requires adequate variation in input prices. This limitation can be circumvented by using an input distance function (IDF), which depends only on input and output quantities. Starting from the transformation function $F(Y, X, T) = 1$ and exploiting the linear homogeneity (degree one) of the IDF in inputs, we obtain:

$$-\ln X_1 = \ln F(1, X^*, Y, T) \Longrightarrow \ln X_1 = \ln F(X^*, Y, T),$$

where $X_k^* = X_k/X_1$. Because the IDF is dual to the cost function (Färe & Primont, 2012), we have $E_{cy} = (\partial \ln X_1)/\partial \ln Y$. For a translog IDF, this elasticity takes the form:

$$E_{cy} = \beta_y + \sum_{k=2}^{J} \beta_{jk} \ln X_k^* + \gamma_{yy} \ln Y + \beta_{yt} T. \quad (3)$$

Substituting (3) into (2) yields:

$$RS = E_{cy} + u = \beta_y + \sum_{k=2}^{J} \beta_{jk} \ln X_k^* + \gamma_{yy} \ln Y + \beta_{yt} T + u. \quad (4)$$

Thanks to duality and the use of the IDF, estimating (4) does not require input price data—a distinct practical advantage.

Given the panel structure of our data, we extend the model in (4) along several dimensions. Crucially, we do not compute u directly from (4), as u might reflect random outcomes unrelated to true markups. To address this, we augment (4) with a noise term incorporating firm-specific unobserved heterogeneity, denoted $v_{it} + \mu_i$. We further introduce observable determinants of markups by specifying u_{it} as a function of variables Z_{it}. This specification allows us to control for measurement error in the revenue share as well as unobserved firm fixed effects when estimating markups.

Final Estimation Model

The final model to be estimated is thus specified as:

$$RS_{it} = \beta_y + \sum_{k=2}^{J} \beta_{jk} \ln X_{kit}^* + \gamma_{yy} \ln Y_{it} + \beta_{yt} T_{it} + \mu_i + v_{it} + u(Z_{it}), i = 1, \dots, N; t = 1, \dots, T.$$

$$u = RS_{it} + \sum_{k=2}^{J} \vartheta_{jk} \ln Z_{kit}^* - \left(\beta_y + \sum_{k=2}^{J} \beta_{jk} \ln X_{kit}^* + \gamma_{yy} \ln Y_{it} + \beta_{yt} T_{it} + \mu_i + v_{it}\right) \quad (5)$$

Determinants of Markups and Market Power

Drawing on the SCP framework, the determinants of markups and market power in the food industry can be categorized into three broad groups:

Structural and Geographical Determinants

Firm size and economies of scale (Kroupova *et al.*, 2025), geographic concentration and cluster benefits (Kroupova *et al.*, 2025), and physical location (Mydland *et al.*, 2022) directly influence a firm's ability to set prices above marginal cost.

Behavioral and Strategic Determinants

Advertising and branding strategies foster product differentiation and consumer loyalty, thereby reducing demand elasticity and increasing markups (Apelbaum, 1999; Ma *et al.*, 2021; Irz & Liu, 2016). Similarly, investment in research and development (R&D) enhances product quality and innovation, further strengthening markups (Ma *et al.*, 2021).

Policy, market structure, and macroeconomic determinants:

Government Policies

Antitrust enforcement, subsidies, and tax policies can either constrain or expand the scope for exercising market power (Ma *et al.*, 2021; Sexton & Xia, 2018).

Market Structure

The degree of industrial concentration, competition patterns, and retailer bargaining power (e.g., through private labels) affect profit margins (Cacchiarelli & Sorrentino, 2019; Kroupova *et al.*, 2025).

Macroeconomic Factors

Globalization (Syverson, 2019), innovation, ESG criteria (Lu, 2024), shifting consumer preferences (Tripathy, 2025), and financial frictions (Syverson, 2019) shape markup dynamics by influencing costs, demand, and competitiveness.

Although these factors have been extensively examined in both international and domestic studies, a dynamic, simultaneous, and quantitative analysis of the interactions and relative impacts of shocks from these structural, behavioral, and macroeconomic factors on market power—specifically within the unique context of Iran's food industry and using structural methods such as panel SVAR—remains largely unexplored. This study aims to fill that gap.

Data Description

This study employs panel data covering 17 four-digit ISIC subsectors of Iran's food industry from 2002 to 2022 (1381–1401 Iranian calendar). These subsectors include: meat processing and preservation; fish, crustacean, and mollusk processing and preservation; fruit and vegetable processing and preservation; manufacture of vegetable and animal oils and fats (excluding corn oil); manufacture of dairy products; manufacture of grain mill products; manufacture of starches and starch products; manufacture of sugar; manufacture of cocoa, chocolate, and sugar confectionery; manufacture of macaroni, noodles, vermicelli, and similar farinaceous products; manufacture of prepared meals and dishes; manufacture of bakery and farinaceous products (excluding sweet bakery); manufacture of other food products not elsewhere classified; manufacture of prepared animal feeds; manufacture of soft drinks; production of mineral and other bottled waters; manufacture of malt; and distillation, rectification, and blending of spirits.

The key variables include the exchange rate, energy costs, firm size, value added, advertising expenditures, intermediate input costs, and the Lerner index.

The dataset contains information on output, capital, labor, intermediate inputs, energy costs, the free-market dollar exchange rate, prices, number of establishments, firm sales, and firm-level advertising expenditures, enabling the estimation of the Lerner index and other relevant indicators. The sample period is determined by the most recent available data. All data were obtained from the Industrial Workshop Survey conducted by the Statistical Center of Iran and from the Central Bank of Iran.

All nominal financial variables were deflated to constant prices using the Producer Price Index (PPI) with 2016 (1395) as the base year. The PPI was preferred over general price indices (such as the GDP deflator) because it more directly reflects price changes at the producer level and is better suited to the nature of industrial data.

Estimation Approaches for Markups

The literature offers a wide range of approaches for estimating markups, with no clear consensus on a single "best" method. In the mid-1980s, the Structure-Conduct-Performance (SCP) paradigm was widely used, wherein economic performance was typically proxied by price-cost margins (e.g., Sheldon & Sperling, 2003; Garcia *et al*., 2022). The SCP framework posits a one-way causal chain from market structure to conduct and then to performance. Subsequently, structural modeling and total cost function estimation gained popularity (e.g., Hyde & Perloff, 1995; Wolfram, 1999; Størdal & Baardsen, 2002). More recently, the New Empirical Industrial Organization (NEIO) approach has been extensively applied. NEIO estimates markups without directly estimating marginal costs, typically by recovering the markup from a supply relation that controls for the determinants of marginal cost (Appelbaum, 1982; Bresnahan, 1982). Perekhozhuk et al. (2017) provide a detailed description of two common NEIO methods—the Production Theory Approach (PTA) and the General Identification Method (GIM). Building on Hall's (1988) methodology, De Loecker (2011) and De Loecker & Warzynski (2012) introduced the Production Function Approach (PFA), which recovers markups from estimates of a production function using production data alone. This approach has been widely adopted in recent studies (e.g., De Loecker *et al*., 2020; Weche & Wagner, 2021).

Production Function Specification

In this study, we adopt a structural approach using the production function method. The production function for industry i in year t is specified as:

$$Q_{it} = A_{it} f(l_{it}, k_{it}, M_{it}) \tag{6}$$

where Q_{it} denotes output, l_{it} is labor input, k_{it} is capital stock, A_{it} is total factor productivity, and M_{it} represents intermediate inputs.

The firm's cost minimization problem is:

$$\min_{L,K,M} \quad W_{it}L_{it} + r_{it}K_{it} + P_{it}^{m}M_{it}$$

$$\text{subject to } A_{it}F(L_{it}, K_{it}, M_{it}) \geq Q_{it} \tag{7}$$

Here, w, r, and P_m denote the prices of labor, capital, and intermediate inputs, respectively. Solving the Lagrangian yields the first-order condition with respect to the intermediate input:

$$P_{it}^{m} = \lambda_{it}\frac{\partial F_{it}}{\partial M_{it}} \tag{8}$$

where λ_{it} is the marginal cost of production. Multiplying both sides by M_{it}/Q_{it} and rearranging gives:

$$\frac{\partial F_{it}}{\partial M_{it}}\frac{M_{it}}{Q_{it}} = \frac{1}{\lambda_{it}}\frac{P_{it}^{m}M_{it}}{P_{it}Q_{it}}P_{it} = \frac{P_{it}}{\lambda_{it}}\frac{P_{it}^{m}M_{it}}{P_{it}Q_{it}} \tag{9}$$

Let $\mu_{it} = P_{it}/\lambda_{it}$ denote the markup. Then, following Khodadkashi *et al*. (2018), we obtain:

$$\mu_{it} = \theta_{it}^{m}(\alpha_{it}^{m})^{-1} \tag{10}$$

where $\theta_{it}^{m} = \frac{\partial F_{it}}{\partial M_{it}}\frac{M_{it}}{Q_{it}}$ is the output elasticity with respect to intermediate inputs, and $\alpha_{it}^{m} = \frac{P_{it}^{m}M_{it}}{P_{it}Q_{it}}$ is the revenue share of intermediate inputs.

Because computing θ_{it}^{m} requires estimating the production function, we must select an appropriate functional form. While Cobb-Douglas and CES specifications are common, the translog functional form is preferred due to its flexibility: it nests simpler forms and allows second-order derivatives. However, without imposing regularity conditions, the translog may not satisfy monotonicity and concavity unless the data are sufficiently rich.

We specify a translog production function with two fixed inputs (labor L_{it} and capital K_{it}), which face high adjustment costs, and one variable input (intermediate inputs M_{it}). The logarithmic form is:

$$\begin{aligned}\ln Q_{it} = {} & \beta_0 + \beta_1 \ln L_{it} + \beta_2 \ln K_{it} + \beta_3 \ln M_{it} \\ & + \beta_{11}(\ln L_{it})^2 + \beta_{22}(\ln K_{it})^2 + \beta_{33}(\ln M_{it})^2 \\ & + \beta_{12}\ln L_{it}\ln K_{it} + \beta_{13}\ln L_{it}\ln M_{it} + \beta_{23}\ln K_{it}\ln M_{it} \\ & + \beta_{123}\ln L_{it}\ln K_{it}\ln M_{it}\end{aligned} \tag{11}$$

where T is a time trend. The output elasticity with respect to intermediate inputs is then:

$$\begin{aligned}\theta_{it}^{m} = \frac{\partial \ln Q_{it}}{\partial \ln M_{it}} = {} & \hat{\beta}_3 + 2\hat{\beta}_{33}\ln M_{it} + \hat{\beta}_{13}\ln L_{it} \\ & + \hat{\beta}_{23}\ln K_{it} + \hat{\beta}_{123}\ln L_{it}\ln K_{it} \\ & + \hat{\beta}_{34}T\end{aligned} \tag{12}$$

After estimating the coefficients of the translog production function from equation (11), we compute the markup and the Lerner index as:

$$\mu_{it} = \hat{\theta}_{it}^{m}(\alpha_{it}^{m})^{-1},$$
$$\text{Lerner}_{it} = \frac{\mu_{it}}{\mu_{it}+1} \qquad (13)$$

Market Concentration: Herfindahl-Hirschman Index (HHI)

To measure market concentration, we use the Herfindahl-Hirschman Index (HHI), defined as:

$$HHI_{it} = \sum_{i=1}^{n} s_{it}^{2} \text{ ,where } s_{it} = \frac{x_{it}}{x}, \sum_{i=1}^{n} s_{it} = 1, 0 < s_{it} < 1 \qquad (14)$$

Here, n is the number of firms, x_{it} is the output of firm i, and x is total industry output. When market shares are expressed as percentages, the HHI ranges from 0 to 10,000. A value of 0 indicates perfect competition; 10,000 indicates pure monopoly. Following standard guidelines (Akhani *et al.*, 2024), an HHI below 1,000 indicates an unconcentrated market; between 1,000 and 1,800 indicates moderate concentration; and above 1,800 indicates high concentration.

Capital Stock Estimation

Estimating the production function requires capital stock data. Due to the lack of official disaggregated capital stock statistics at the four-digit industry level, we estimate capital stock using the exponential method. This method uses investment data from 2002 to 2022 for the 17 four-digit food industry subsectors.

We begin with the exponential investment function and Taking logarithms:

$$I_i = I_{it}e^{it}$$
$$\ln I_i = \ln I_0 + \lambda T + u_i \qquad (15)$$

Taking the antilogarithm of the intercept and dividing by the investment growth rate (the coefficient of the time variable) yields the base-year capital stock (K_0) without depreciation:

$$K_0 = \frac{I_0}{\lambda} \qquad (16)$$

After obtaining the base-year capital stock, we use the Klein method to compute capital stock in subsequent periods:

$$K_{it} = K_0 + \sum_{i=1}^{t}(I-D)_i \qquad (17)$$

In equation (17), the depreciation rate (D) is set at 0.04 (4%) for all industries. This rate is consistent with international standards and is reasonable for the food industry. The same rate has been used in reputable domestic studies (e.g., Akhani *et al.*, 2024), implying an average useful life of approximately 25 years for processing machinery and equipment, which is conventional for this sector.

The Structural Vector Autoregression (SVAR) model has become a widely used econometric tool among empirical researchers, particularly those interested in studying the dynamics among economic variables. the SVAR framework was developed by imposing theoretical restrictions on the contemporaneous effects of shocks. Subsequently, Blanchard and Quah (1989), Gali and Clarida (1994), and Ahmed and Gerrat (1996) identified impulse response functions by imposing theoretical restrictions on the long-run effects of shocks.

Unlike unrestricted VAR models, where the identification of structural shocks is often implicit and ad hoc, the SVAR approach explicitly incorporates an economic rationale or economic theory to impose identifying restrictions. However, as is common in many econometric frameworks, countless studies could be conducted using the SVAR approach, but the lack of time series data with sufficient length often prevents this. This problem can be partially addressed using the novel Panel SVAR (PSVAR) method. By exploiting cross-sectional variation in panel data, the PSVAR approach compensates to some extent for the lack of long time series. This extended approach is consistent with the traditional time series SVAR literature.

Following Pedroni (2013), the system of equations in the PSVAR approach can be expressed as follows:

$$Y_{i,t} = \Gamma(L)Y_{i,t-1} + \eta_i + \varepsilon_{i,t} \qquad (18)$$

Based on equation (18), the panel data generating process (DGP) consists of N cross-sectional units observed over T time periods, each containing a vector of K observable endogenous variables.

The vector of endogenous variables is:

$$Y_{i,t} = (EXCH_{i,t}, ENERGY_{i,t}, SIZE_{i,t}, VA_{i,t}, ADV_{i,t}, M_{i,t}, L_{i,t})$$

where:

- $EXCH_{i,t}$: exchange rate
- $ENERGY_{i,t}$: energy costs
- $SIZE_{i,t}$: firm size (concentration index)
- $VA_{i,t}$: value added
- $ADV_{i,t}$: advertising expenditures
- $M_{i,t}$: intermediate input costs
- $L_{i,t}$: markup / market power (Lerner index)

The main objective of this study is to investigate the shocks affecting Iran's food industry on markups or market power.

The model parameters are presented in matrix A, which captures the contemporaneous correlations among the model variables and embodies the identification assumptions. To eliminate fixed effects and simplify notation, the transformed data vector is defined as:

$$\tilde{Y}_{i,t} = Y_{i,t} - \bar{Y}_i \qquad (19)$$

where $\bar{Y}_i$ is the cross-sectional mean. In the PSVAR model, the vector of structural shocks, $\varepsilon_{i,t}$, is assumed to be white noise (Pedroni, 2013).

Identification Strategy: Blanchard-Quah Approach

Following Blanchard and Quah (1989), the identification of structural shocks is achieved by imposing a series of restrictions on the long-run effects of shocks on certain variables. The number of effective restrictions on the PSVAR equation equals $K(K-1)/2$ imposed on the $A(1)$ matrix. In the present study, given the number of variables ($K = 7$), the number of restrictions is 21. The ordering of variables in the $A(1)$ matrix proceeds from least endogenous to most endogenous.

The structural disturbance vector is $\varepsilon = (\varepsilon^{exch}, \varepsilon^{energh}, \varepsilon^{HHI}, \varepsilon^{VA}, \varepsilon^{adv}, \varepsilon^{M}, \varepsilon^{L})'$,

where:

ε^{L}: market power shock

- ε^{M}: intermediate input cost structure shock
- ε^{adv}: advertising cost shock
- ε^{VA}: value added shock
- ε^{HHI}: firm size (concentration index) shock
- ε^{energh}: energy and fuel shock
- ε^{exch}: exchange rate shock

Following the Blanchard-Quah approach, three sets of restrictions are imposed to achieve identification in the markup model:

$$\begin{bmatrix} \varepsilon^{exch} \\ \varepsilon^{energh} \\ \varepsilon^{HHI} \\ \varepsilon^{VA} \\ \varepsilon^{adv} \\ \varepsilon^{M} \\ \varepsilon^{L} \end{bmatrix} = \begin{bmatrix} + & 0 & 0 & 0 & 0 & 0 & 0 \\ + & + & 0 & 0 & 0 & 0 & 0 \\ + & + & + & 0 & 0 & 0 & 0 \\ - & - & + & + & 0 & 0 & 0 \\ + & + & + & + & + & 0 & 0 \\ + & + & - & - & - & + & 0 \\ - & - & + & + & + & - & + \end{bmatrix} \begin{bmatrix} u^{exch} \\ u^{energh} \\ u^{HHI} \\ u^{VA} \\ u^{adv} \\ u^{M} \\ u^{L} \end{bmatrix} \qquad (20)$$

First Set of Restrictions: Small Open Economy Assumption

The first set of restrictions relates to the small open economy assumption. These restrictions implicitly state that domestic shocks have no long-run effects on external variables. In other words, market power, intermediate costs, advertising, value added, firm size, and energy cost shocks have no long-run effect on the exchange rate. These restrictions imply zero values in the northeast quadrant of the coefficient matrix. Thus, in the first row, all elements except a_{11} are zero.

Second Set of Restrictions: Theoretical Long-Run Effects

The second set of restrictions, derived from the theoretical model, imposes constraints on the long-run effects of structural shocks on domestic endogenous variables. These restrictions correspond to zeros in the southeast quadrant of the $A(1)$ matrix, meaning that a particular structural disturbance does not have a long-run effect on the level of certain endogenous variables.

The exchange rate, energy costs, and intermediate input costs—as key factors affecting production costs and market structure—are consistent with the theoretical foundations of market power and the Lerner index. The exchange rate, especially in food industries with international markets, can influence firms' pricing power through its effect on imported raw material costs and export competitiveness. According to the theoretical framework of globalization, exposure to international trade acts as a disciplinary force on profit margins (Syverson, 2019), which can either decrease or increase the Lerner index, depending on whether firms gain more market power in export markets or face intensified competition. Energy costs and intermediate input costs, as major components of production costs, directly affect firms' marginal costs and alter the Lerner index through their effect on the price-to-marginal cost ratio. In the food industry, reducing production costs through industrial clusters or economies of scale (as noted in Kroupova *et al.*, 2025) can increase profit margins and raise the Lerner index, especially in regions with strong infrastructure (Mydland *et al.*, 2022).

Firm size (concentration index) and advertising expenditures, as structural and behavioral factors within the SCP framework, are well-aligned with the theoretical foundations of market power. Firm size, often measured by market concentration indices such as the Herfindahl-Hirschman Index (HHI), has a positive effect on the Lerner index because larger firms benefit from economies of scale, better access to capital, and greater bargaining power (Kroupova *et al.*, 2025). This is evident in the food industry, particularly in sectors such as grains and meat, where market power increases retail margins by up to 60% (Irz & Liu, 2016). Advertising expenditures, by creating product differentiation and brand loyalty, generate inelastic demand, thereby raising the Lerner index through increased pricing power (Ma *et al.*, 2021). Empirical evidence suggests that advertising intensity serves as a proxy for market power and has a strong correlation with the Lerner index (Wang *et al.*, 2025). These variables increase markups by enhancing strategic positioning and reducing perceived substitutes, especially in food retailing (Apelbaum, 1999).

Value added, as a measure of productivity and innovation, is consistent with theoretical foundations related to innovation and resource allocation and has a direct impact on the Lerner index. Innovation, through research and development (R&D), increases profit margins by enhancing product quality and creating differentiation, leading to a higher Lerner index (Syverson, 2019). In the food industry, value added is created through improvements such as quality, packaging, and sustainability, which strengthen consumer demand and increase market power (Lu, 2024; Ma *et al.*, 2021). Furthermore, value added can indicate efficiency in resource use, which raises the Lerner index by reducing marginal costs.

Third Set of Restrictions: Orthogonality of Structural Shocks

The third set of restrictions, necessary to complete the identification process, assumes no correlation among structural shocks. In practice, this assumption is implemented through the Cholesky decomposition of the variance-covariance matrix of model residuals, considering a specific ordering of variables (equation 20) based on their relative endogeneity. This ordering produces orthogonal shocks and ultimately enables full identification of the $A(1)$ matrix and the computation of impulse response functions.

It should be noted that to analyze the effects of shocks—namely, impulse response functions and variance decomposition—we used EViews software, following Pedroni (2013).

Results and Discussion

Before estimating the Lerner index, unit root tests were conducted for all variables. Table 1 presents the PP-Fisher unit root test results for the production function variables. As shown, all variables are stationary at the 5% level. The F-test confirmed the panel structure of the model. The Hausman test indicated that the random effects model is appropriate. The White test revealed heteroscedasticity ($p < 0.05$), so GLS estimation was employed. The Jarque-Bera normality test (statistic= 1.86) indicated that the error terms are normally distributed.

Table 1- Unit root test of variables under study in the model at the level

Variables under investigation	PP-Fisher	
	Statistics	Probability
Logarithm of production	301.102	0.004
Logarithm of employment	303.062	0.003
Logarithm of employment × Logarithm of employment	319.444	0.000
Logarithm of capital stock	2586.38	0.000
Logarithm of capital stock × Logarithm of capital stock	2489.54	0.000
Logarithm of intermediate input cost	303.43	0.003
Logarithm of intermediate input cost × Logarithm of intermediate input cost	300.25	0.005
Logarithm of employment × Logarithm of capital stock	313.75	0.000
Logarithm of intermediate input cost × Logarithm of capital stock	284.41	0.052
Logarithm of intermediate input cost × Logarithm of employment	305.75	.0002
Logarithm of intermediate input cost × Logarithm of employment × Logarithm of capital stock	306.86	.0001
Logarithm of capital stock × Time	556.49	0.000
Logarithm of employment × Time	308.47	0.001
Logarithm of intermediate input cost × Time	244.41	0.057

Source: Researcher's findings

Table 2 presents the panel data estimation results for the translog production function. The overall model is significant (F-statistic probability< 0.05). The R^2 and adjusted R^2 values (0.95) indicate that 95% of the variation in the dependent variable is explained by the independent variables. Some interaction terms (lnL·lnK·lnM, lnK·T, lnM·T) are not statistically significant. Based on these estimation results, markups and Lerner indices were calculated for each of the 17 four-digit subsectors over the period 2002–2022.

Before estimating the PSVAR models, the stationarity of all study variables was examined. For this purpose, the Levin, Lin & Chu (LLC) test was used to test for panel unit roots. Table 3 presents the LLC unit root test results. As observed, the null hypothesis of non-stationarity is rejected for all variables, confirming that all model variables are stationary. Having established stationarity, there is no need for cointegration tests.

Table 4 presents the optimal lag length selection criteria. Although alternative criteria (AIC, HQ, FPE) suggested an optimal lag of 8, the Schwarz criterion (SC) selected lag 1. Given that choosing a larger lag would result in a greater loss of degrees of freedom, lag 1 was selected as the optimal lag based on the Schwarz test. Stability tests confirmed that all eigenvalues lie within the unit circle, indicating model stability (Appendix 1).

Among the shocks examined (excluding the variable's own shock), intermediate input cost structure and value added shocks have the largest effects on markups in the first period. Energy cost and advertising cost shocks follow in terms of impact magnitude.

Table 2- Results of the panel data model for estimating the Lerner index

Variables under investigation	Result estimation	
	Statistics	**Probability**
Intercept	0.748	0.432
Logarithm of employment	1.402	0.000
Logarithm of capital stock	-0.324	0.003
Logarithm of intermediate input cost	0.201	0.038
Logarithm of employment × Logarithm of employment	0.094	0.000
Logarithm of capital stock × Logarithm of capital stock	0.009	0.000
Logarithm of intermediate input cost × Logarithm of intermediate input cost	0.038	0.000
Logarithm of employment × Logarithm of capital stock	-.0073	0.000
Logarithm of intermediate input cost × Logarithm of capital stock	0.071	0.000
Logarithm of intermediate input cost × Logarithm of employment	-0.162	0.000
Logarithm of intermediate input cost × Logarithm of employment × Logarithm of capital stock	0.0001	0.844
Time	0.068	0.000
Time × Time	0.001	0.001
Logarithm of capital stock × Time	-0.001	0.261
Logarithm of employment × Time	0.006	0.013
Logarithm of intermediate input cost × Time	-0.001	0.296
R-squared	0.95	
Adjusted R-squared	0.95	
F	0.000	**3257/57**

Source: Researcher's findings

Table 3- Unit root test of variables under study in the model at the level

Variables under investigation	LLC	
	Statistics	Probability
EXCH	-5.35353	0.0000
ENERGH	-3.93858	0.0000
HHI	-5.327	0.0548
ADV	- 9.3001	0.0000
M	-7.74475	0.0000
VA	- 5.1771	0.0952
L	-1.68923	0.0456

Source: Researcher's finding

Table 4- Optimal LAG determination test

LAG	HQ	SC	AIC	LR	LogL
0	14.81	14.87	14.76	NA	-1617.44
1	1.87	* 2.39	1.52	2900.93	-112.24
2	1.96	2.92	1.30	137.05	-38.70
3	2.30	3.72	1.34	80.14	5.82
4	2.34	4.21	1.08	135.56	83.89
5	1.75	4.06	0.18	247.75	232.00
6	1.74	4.51	-0.12	133.94	315.25
7	1.58	4.80	-0.59	154.70	415.35
8	1.62*	5.29	* -0.86	* 116.331	493.86

Source: Researcher's finding

Exchange rate shock induces an immediate negative response in the Lerner index during the first two to three periods. This occurs because increased imported raw material costs reduce profit margins and force firms to lower prices to maintain market share, consistent with the competitive pressures of international trade (Syverson, 2019). The return of this effect to zero indicates firms' gradual adjustment to new exchange rate conditions.

Energy cost shock also generates a negative response, as rising production costs—particularly in Iran's food industry, which is affected by energy subsidies—reduce profit margins and weaken the pricing power of smaller firms (Akhani *et al*., 2024).

Market concentration shock (HHI) produces a positive and diverging response in the Lerner index. Reduced structural competition and enhanced economies of scale in concentrated markets, such as the bread and beverage sectors, increase firms' pricing power (Kroupova *et al.,* 2025; Irz & Liu, 2016; Khodadkashi *et al.,* 2018). The temporal divergence emphasizes the importance of considering the time horizon and institutional dynamics in market structure analysis.

Value added shock generates a positive response. Innovation and product quality improvements through sustainability (ESG) and packaging reinforce inelastic demand and increase profit margins, consistent with the role of productivity in market power (Syverson, 2019; Lu, 2024; Ma *et al*., 2021).

Advertising cost shock has a mild effect on the Lerner index. The widespread use of advertising in food retail neutralizes product differentiation effects and leads to competitive equilibrium (Ma *et al*., 2021; Apelbaum, 1999). In other words, advertising in Iran's food industry is primarily informational and, due to legal constraints, media concentration, and consumer price sensitivity, plays a limited role in product differentiation and increasing market power. This finding is consistent with Iran's market structure, which is more influenced by exchange rates, energy subsidies, and input costs. Thus, advertising in this industry is a supplementary cost with no significant impact on competitiveness.

Intermediate input cost shock has a negative and significant effect on market power, consistent with theory. According to pricing theory, an increase in average cost reduces profit margins, which lowers the Lerner index.

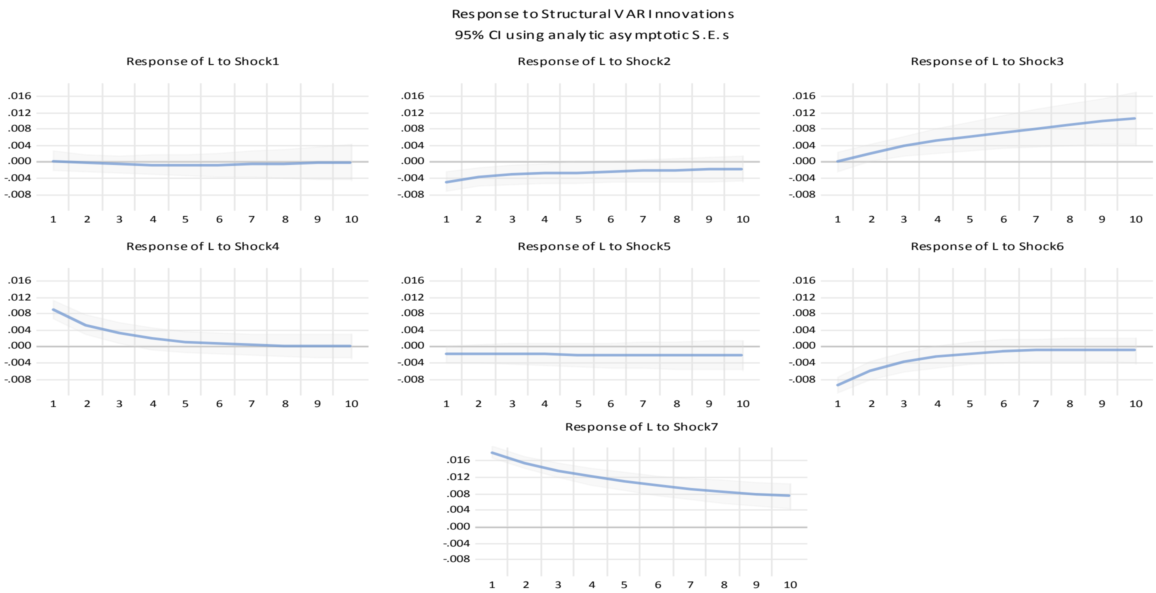


Chart 1- The effect of Impulse Response Function (IRF) on the market power of industries in Iran
Source: Researcher's findings

These findings, by combining structural factors (concentration, value added), behavioral factors (advertising), and production costs (exchange rate, energy, intermediate inputs), provide a comprehensive understanding of market power dynamics in Iran's food industry, highlighting the key role of market structure and innovation in strengthening profit margins. From an economic perspective, price determination and market power formation in Iran's food industry are more dependent on variables such as the exchange rate, energy subsidies, market regulation policies, and input costs than on advertising and branding. In such a structure, advertising plays a minor role in changing consumer behavior or redistributing market share.

From a behavioral perspective, domestic consumers in the food sector are more sensitive to price than to brands or advertising. In other words, consumer decision-making in this area is more based on price and product availability than on the extent of brand advertising. Consequently, even increases in firms' advertising expenditures do not lead to significant changes in market power (Lerner index).

Variance Decomposition

Variance decomposition indicates the relative contribution of each variable to the variation in other variables. Table 5 presents the variance decomposition of common shocks on market power.

Table 5- Analysis of variance Decomposation of market power of industries in Iran

Period	S.E.	Market power shock	Value added shock	Intermediate cost shock	Advertising shock	Market size shock	Energy cost shock	Exchange rate shock
1	0.23	62.15	17.0	0.68	15.61	0.002	4.49	0.01
2	0.33	66.59	14.68	0.74	12.95	0.55	4.44	0.01
3	0.42	69.07	12.80	0.85	11.04	1.75	4.41	0.04
4	0.50	70.03	11.33	1.00	9.64	3.53	4.36	0.07
5	0.57	69.87	10.16	1.16	8.58	5.79	4.30	0.10
6	0.65	68.91	9.21	1.33	7.73	8.45	4.22	0.12
7	0.72	67.37	8.42	1.47	7.04	11.42	4.11	0.12
8	0.80	65.43	7.75	1.60	6.45	14.64	3.98	0.12
9	0.87	63.20	7.16	1.68	5.93	18.04	3.83	0.12
10	0.95	60.77	6.64	1.73	5.47	21.57	3.67	0.11

Source: Researcher's findings

The results show that among the shock variables, the largest share (17%) in explaining variation in market power is attributable to intermediate input costs. The relative share of exchange rate shocks in market power variation is 0.01% in the first period, gradually increasing over time. The share of energy and fuel cost shocks is 4.49%. The smallest share is for concentration (firm size) shocks, although its contribution increases over the 10-year horizon. The share of value added and output shocks on market power is over 15%, with a gradual decline over time. Advertising cost shocks have a 0.68% share in market power variation.

The variance decomposition analysis of market power (Lerner index) in the food industry reveals that firm costs are the most important factor affecting market power variation, with a substantial portion of this indicator's fluctuations depending on this factor. Output and value added also play significant roles. The exchange rate has a limited effect initially, but its importance increases over time, likely due to the food industry's dependence on imports or exports. Concentration/firm size has the smallest impact, although its role gradually becomes more prominent, potentially reflecting firm growth or structural changes in the industry. Advertising costs have a negligible role, indicating the limited impact of advertising strategies on market power in this industry. Overall, to strengthen market power in the food industry, focusing on firm cost management and production optimization may be more effective than other factors, while attention to long-run exchange rate trends and firm structure is also essential.

Conclusion

In general, analyzing market power in the food industry is of great importance. This issue not only affects competition and pricing but can also influence food safety and economic welfare. By analyzing the factors affecting market power, stakeholders can better navigate the complexities of the food market and implement policies to promote fair competition and protect consumer interests.

This study aimed to investigate the effects of shocks on market power in 17 Iranian industrial firms following Mydland *et al.* (2022) within the Structure-Conduct-Performance (SCP) framework at the four-digit ISIC level over the period 2002–2022 using a Panel SVAR model. Accordingly, a translog production function was used to calculate market power in Iran's food industries. Capital stock was calculated using the Klein method. Exchange rate, fuel and energy costs, concentration index, value added, advertising costs, and intermediate input costs were used to examine these effects. The innovations of this study include analyzing the dynamic relationship and econometric model, as well as examining the variables affecting market power within the SCP framework in Iran's food industry.

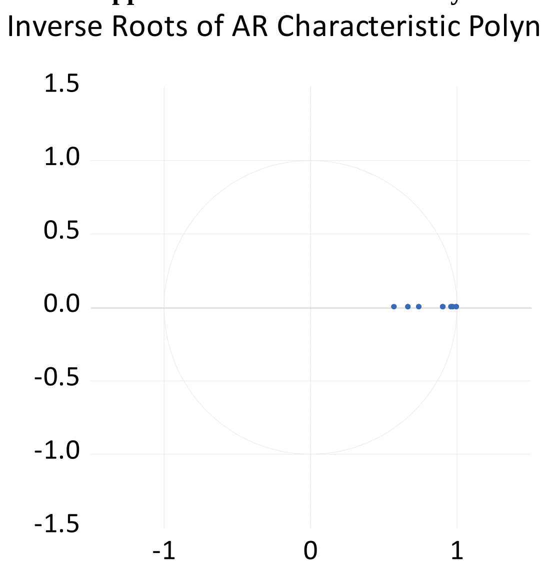
The impulse response and variance decomposition analyses of the Lerner index in Iran's food industry show that market power in this industry is primarily influenced by structural and cost factors such as firm costs, value added, and energy costs, while behavioral factors such as advertising play a limited role. Firm costs, with a substantial share (17%), are the most important determinant of market power variation, indicating the strong influence of production costs on profit margins and firm pricing. Value added and output also play key roles in increasing market power by strengthening demand through innovation and quality improvement, although their effects diminish in the long run. The exchange rate, despite having a small negative initial effect, becomes more important over time due to the industry's dependence on international trade. Energy costs, due to the influence of subsidies and the food industry's sensitivity to production costs, weaken the pricing power of smaller firms.

In contrast, market concentration (HHI) has a positive and diverging effect on the Lerner index by enhancing economies of scale. Reduced structural competition and enhanced scale economies in concentrated markets, such as the bread and beverage sectors, increase firms' pricing power. The temporal divergence emphasizes the importance of considering the time horizon and institutional dynamics in market structure analysis. Advertising, due to legal constraints, media concentration, and domestic consumers' high price sensitivity, has a negligible effect on market power and acts largely as a supplementary cost.

These findings are consistent with the SCP theoretical framework and demonstrate that market power in Iran's food industry is more dependent on structural variables (costs and concentration) and macroeconomic policies (exchange rate and energy subsidies) than on behavioral strategies such as advertising.

From an economic perspective, the dynamics of market power in Iran's food industry reflect the industry's high dependence on cost and structural factors. Firm and intermediate input costs, due to their direct impact on profit margins, play a key role in determining the Lerner index. This implies that firms in this industry must focus on optimizing production costs and managing inputs to maintain competitiveness. The negative effect of the exchange rate in the early periods, particularly due to dependence on imported raw materials, indicates the food industry's vulnerability to exchange rate fluctuations, but the gradual adjustment of firms to new exchange rate conditions demonstrates the industry's relative flexibility. The negative impact of energy costs, given Iran's energy subsidy structure, creates particular challenges for smaller firms that have less capacity to absorb cost shocks. On the other hand, market concentration and economies of scale contribute to increased pricing power, highlighting the importance of market structure in determining competitive power. The limited role of advertising is consistent with domestic consumer behavior, which is primarily sensitive to price and product availability. This suggests that in Iran's food market, branding and advertising strategies alone cannot create sustainable competitive advantage.

Appendix 1- Parameter Stability Tests



Policy Recommendations

1. **Production Cost Management:** Given the key role of firm costs in market power variation, food industry firms should focus on optimizing production processes, reducing waste, and improving input supply chains. The use of modern technologies and efficient production methods can reduce marginal costs and strengthen profit margins.
2. **Strengthening Innovation and Value Added:** Given the positive effect of value added on market power, firms should prioritize investment in innovation, product quality improvement, and sustainability (such as green packaging or ESG criteria). These actions can reinforce inelastic demand and increase pricing power.
3. **Exchange Rate Risk Management:** Given the increasing effect of exchange rates on market power, firms should adopt strategies such as diversifying input supply sources, using exchange rate hedging contracts, or increasing domestic production of raw materials to reduce import dependence.
4. **Focus on Market Structure:** Policies that moderate competition in concentrated markets (such as bread and beverages) can prevent excessive monopoly and balance pricing power. At the same time, supporting economies of scale for larger firms can increase industry productivity.
5. **Revising Advertising Strategies:** Given the limited effect of advertising, firms should focus on targeted information dissemination, digital marketing, and strengthening access to local markets rather than extensive investment in traditional advertising. This approach can reduce unnecessary costs and align with Iranian consumer behavior.
6. **Strengthening Market Regulation Policies:** Policymakers should mitigate the negative effects of external shocks on

market power by establishing appropriate regulations, such as controlling exchange rate fluctuations and supporting domestic production. Creating stability in macroeconomic policies can assist firms in long-term planning.

These recommendations—focusing on cost management, innovation strengthening, and market structure improvement—can enhance the competitiveness and sustainability of Iran's food industry while remaining aligned with the economic and behavioral realities of the domestic market.

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اثر تکانه‌های ساختاری و رفتاری بر قدرت بازاری صنایع غذایی در ایران

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چکیده

این پژوهش با هدف بررسی اثر تکانه‌های ساختاری و رفتاری بر قدرت بازار در ۱۷ زیربخش (کد چهار رقمی ISIC) صنعت غذایی ایران طی سال‌های ۱۳۸۱ تا ۱۴۰۱ انجام شده است. مطالعه حاضر با به‌کارگیری مدل خودرگرسیون برداری ساختاری تابلویی (PSVAR) در چارچوب ساختار-رفتار-عملکرد (SCP) برای اولین بار در این زمینه، امکان تحلیل پویای تعاملات بین شوک‌های ساختاری و رفتاری را فراهم می‌سازد. متغیرهای ساختاری و رفتاری مورد بررسی شامل نرخ ارز، هزینه انرژی، شاخص تمرکز، ارزش افزوده، هزینه تبلیغات و هزینه نهاده‌های واسطه‌ای بودند. نتایج تجزیه واریانس نشان می‌دهد که بیش از ۸۰ درصد تغییرات قدرت بازار (شاخص لرنر) توسط عوامل ساختاری و هزینه‌ای (شامل هزینه نهاده‌های واسطه‌ای، ارزش افزوده، انرژی و نرخ ارز) توضیح داده می‌شود. هزینه نهاده‌های واسطه‌ای مهم‌ترین عامل اثرگذار منفی بر قدرت بازار شناسایی شده است. تمرکز بازار اثر مثبت و ارزش افزوده نیز از طریق نوآوری، اثر تقویت‌کننده داشته است. در مقابل، عوامل رفتاری مانند تبلیغات، با سهمی کمتر از ۱٪، نقش کاملاً حاشیه‌ای داشته و به‌دلیل محدودیت‌های نهادی و حساسیت قیمتی مصرف‌کننده، نتوانسته‌اند تأثیر معناداری بر قدرت قیمت‌گذاری بنگاه‌ها بگذارند. این یافته‌ها مؤید آن است که قدرت بازار در صنایع غذایی ایران عمدتاً تابعی از ساختار هزینه‌ها، تمرکز صنعتی و سیاست‌های کلان اقتصادی است، نه استراتژی‌های رفتاری بنگاه‌ها. بر این اساس، با توجه به نقش کلیدی عوامل ساختاری و هزینه‌ای در قدرت بازار صنایع غذایی ایران، پیشنهادات سیاستی شامل مدیریت هزینه‌های تولید، تقویت نوآوری و ارزش افزوده، مدیریت ریسک ارزی، تنظیم ساختار بازار، بازنگری در استراتژی‌های تبلیغاتی و تقویت سیاست‌های تنظیم بازار ارائه شده است.

واژه‌های کلیدی: پانل SVAR، شاخص لرنر، صنایع غذایی، قدرت بازاری،
طبقه‌بندیJEL: D24, L11, L60, C33, O14

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