

## ESTIMATING MARKET POWER OF RICE EXPORTERS TO IRAQ DURING THE PERIOD (2005-2021)

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### ABSTRACT

This study aimed to determine and analyze market power among rice exporters to the Iraqi market by estimating the residual demand for different types of rice. Four countries were included in the study: Thailand, India, Pakistan, and the United States of America. The inverse residual demand elasticity of these countries was measured during the study period, 2005-2021. The results showed market power among the countries supplying rice to the Iraqi market. Thailand has greater market power than the United States due to lower export prices and a weaker local currency. On the other hand, competition between Pakistan and India was intense in the Iraqi rice market. The study recommended government intervention to support farmers in improving productivity, enhancing food security, and reducing dependence on imports.

**Keywords:** competitiveness, import market, residual demand, seemingly unrelated regression system of equations.

\* Part of the M.Sc. thesis of the 1<sup>st</sup> author.



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**Received: 12/4/2024, Accepted: 3/7/2024, Published: 31/3/2026**

### INTRODUCTION

Rice has been grown in Iraq for many years, and it is one of the most essential summer crops in central and southern Iraq (Al-Musawi, A.S.T., and A.M.H. Majid. 2012). Rice is a strategic grain crop and ranks third in importance after wheat and barley. Rice is vital because it contains a high percentage of carbohydrates and balanced amino acids that help humans obtain energy (Jabbar, F.A. and A.A. Jasim. 2023). Rice husk is also an inexpensive natural material used to treat wastewater from heavy metals (Majeed, M., A. Muhammed, and K. Rasheed. 2014). The peels are used with charcoal as an acceptable absorbent to remove the violet color from aqueous solutions (Abd Mousa, S. 2020). Because the crop is highly dependent on water, it is grown in small areas due to limited water availability, underscoring that water resources are a positive or negative factor affecting crop production. Also, rice is one of the largest freshwater crops in the world (Hassan, S.F., K.A. Hameed, A.K.H. Ethafa, A.N. Kadim, A.H.Y. Abbod, A.R.H. Ali, and F.I. Khalil.

2015). In addition, rice farmers face many difficulties, including low harvest prices, weed control, and the great effort required to grow the crop (Kshash, B.H., and H.K. Oda. 2022). Since the costs of the used resources are increasing, this leads to a decrease in the efficiency of using the resource, and thus a decrease in farmers' returns. The limited water resources due to environmental conditions make it difficult to grow the crop. This prompted Iraq to import rice from several countries to meet local demand (Obaid, R.I., 2019). Agricultural imports are considered part of agricultural activity, as they provide essential agricultural and food commodities to address production deficits and meet increasing demand. On the other hand, imports have severe financial consequences because they drain foreign currency (Husain, W.A. and A.N. Al-Heali. 2020). Nearly 90% of rice is imported for consumption due to high daily consumer demand in Iraq (Jarjees, F.Z., and D.A. Darwesh, 2023). Iraq imports rice from several origins, including Thailand, India, the United States of America, and Pakistan, which

are among the major rice-exporting countries. This study is important because it identifies and measures market power in the Iraqi rice import market, determines which foreign exporters control it, and examines the competitive situation among them. A product differentiation approach will be adopted based on the origin of imported rice. Therefore, the results of this study will be essential for understanding the nature of competition among exporters of this commodity and the extent to which each controls the private market for it. This study assumes that some countries have greater market power in exporting rice than other competing countries.

### MATERIALS AND METHODS

1- Analysis method: The demand for various crop imports will be studied according to origin or what is usually called (product differentiation according to the destination). The demand function will be described for each type of rice according to origin. These functions are estimated in the form of simultaneous equations using the estimation method of seemingly unrelated regression (SUR) in the form of a system of equations for exporting countries to clarify the exporter's position in the Iraqi market. Eviews 12 software program was used for the analysis.

2- Data sources: Data were taken from several secondary sources such as the published bulletin of the Central Organization of Statistics / Ministry of Planning of Iraq, and the database of the Food and Agriculture Organization (FAO), and World Bank published datasets.

#### Theoretical framework: Market power:

Market power is defined economically as the company's ability to influence the price at which it sells the good, product, or service by manipulating the supply or demand for the good, product, or service to increase economic profit (Landes, W.M. and R.A. Posner. 1997). It is also known as the ability of a company to influence the price at which it sells its products or services. That is, market power occurs if the company does not face elastic demand and can set a price higher than the marginal cost without losing revenue. This makes it clear that market power is a gap between price and marginal cost at the level of production that

maximizes the company's profit. The size of the gap that shows the extent of a company's control over a market is determined by the residual demand curve, and the steeper the inverse residual demand curve, the higher profits and control over the market (Syverson, C. 2019). To determine an appropriate price, the dominant company must anticipate the subsidiaries' behavior, and, according to this principle, the controlling company will work to ensure the subsidiaries' profit. For example, in the case of market equilibrium, the subsidiary company will change its price at the same price as the controlling company, and if it is assumed that there are two companies selling an identical product and one of them imposes a certain price, the consumer will prefer the product with the lower price, so equilibrium cannot exist in the production of the two companies, because the subsidiary company can take this price and choose the production that achieves the greatest profit. That is, in a perfectly competitive market, the price is beyond the control of any company because it is a small part of the market. In the market power model, the subsidiary's price is outside its control because it is set by the controlling company. The quantity sold by the controlling firm is:

$$R_p = D_p - S_p$$

This equation is known as the residual demand curve  $R_p$ , which is the market demand  $D_p$  minus the subsidiary's production  $S_p$ . Suppose that the controlling company has a fixed cost to achieve production, which we symbolize as (C), and is used to achieve a profit at a price:

$$\pi_p = (p - c)\{D_p - S_p\}$$

$$(p - c)R_p$$

To achieve the maximum possible profit, the controlling company must choose an appropriate price that maximizes production, which is done by equating marginal revenue and marginal cost. Here, marginal revenue is the remaining demand curve.

#### Indicators of market power

1- **Concentration Ratio (CR):** It is a simple and easy-to-use indicator because it requires specific data and shows the degree to which a group of large companies is controlled compared to the small ones (Repková, I.

2012). This indicator requires only revenue data, making it easy to calculate. One of its disadvantages is its reliance on revenue data rather than cost or profit data. Also, this indicator is a result and not a determinant that affects the extent of competition between markets or industries, as the nature and intensity of competition for a market combine with the beginning of supply and demand to determine the balance, meaning that the conditions of competition are what push the market to focus and not the other way around. The formula of the indicator is:

$$CR_k = \sum_{i=1}^k C_i$$

Where:  $CR_k$ : Represents the market share of the largest company in the market, which is a percentage.

K: Represents the number of major companies in the market.

If the concentration rate is 0%, the market has low concentration; if it is 100%, the market has high concentration.

**2- Herfindahl-Hirschman Index (HHI):** It is a measure of market concentration and is used to show the competitiveness of a market. This indicator measures the size of the company relative to the market in which it operates and the level of competition. It is defined as the sum of the squares of the market share sizes (Bikker, J.A. and K. Haaf. 2002). The indicator is used with a simple system in which market behavior is related to market structure. The larger the company's market share, the more likely it is to regulate super-competitive pricing. This indicator is calculated using the following equation:

$$HHI = \sum_{i=1}^N Ms_i^2$$

Where:

Ms: is the company's market share. It is a percentage and is expressed in whole numbers, not decimals.

N: The number of companies in the market.

When the value of this indicator equals one, this means the existence of a monopoly market, and if it equals  $1/N$ , it means the existence of a perfectly competitive market. If we multiply the index value by 10,000 and the

result is less than 1,000, the concentration in this market will be low, and if the result is equal to 10,000, the concentration will be complete and high in the market, and this will be in a monopoly market.

**3- Lerner index:** It is a direct measure of competition because of its clear focus on pricing power, which shows the difference between marginal cost and price, and therefore it shows the degree to which a company is able to increase its price above its marginal cost (Demirgüç-Kunt, A. and M.S. Martínez Pería. 2010). It is defined mathematically by the following equation:

$$L = \frac{P - Mc}{P}$$

Where:

L: Lerner index, its value ranges between (0-1)

P: Price set by the company.

Mc: The firm's marginal cost.

When price equals marginal cost, the value of the index = 0, meaning that the company does not have market power as is the case in a perfectly competitive market. However, if the price rises above marginal cost and the value of the index = 1, then the company has market power as in a monopoly market. Therefore, this indicator is called the inverse measure of competition, that is, the greater the value of the indicator, the less competition it indicates.

### Rice production in Iraq

Rice is grown in the central and southern regions, and this crop requires huge amounts of water. It is also used in many vital industries and other industries such as the feed industry. Despite the importance of the rice crop, its production faces many obstacles that reduce production. The most important challenge is the severe scarce in water due to the shortage of flows from the Tigris and Euphrates rivers (Al-Badri, B.H., M.K. Mohammad and J.O. Khalid. 2023). Secondly, the use chemical fertilizers that help in the crop growth process, either because of the inefficiency of using these fertilizers or because of high prices. Also, there was no utilization of cheap bio-fertilizers, for example, the types of cyanobacteria that are considered bio-fertilizers as an alternative to expensive industrial chemical fertilizers that contributes to soil and water pollution

(Rasheed, F.T. and M.S. Mahdy. 2017). Furthermore, weak agricultural extension related to delivering guidance to rice farmers on how to use rice waste in manufacturing, for example, fertilizer manufacturing in order to eliminate environmental pollution. The phenomenon of global warming causes temperatures to rise and causes changes in the cultivated area and distribution of rain is another challenge, which causes desertification and drought. Add to that the low marketing efficiency due to administrative procedures that make farmers sell their product directly to the market at low prices. Also, advanced technologies were not adopted in the production. These technologies should increase agricultural production to enable farmers to obtain maximum profits, reduce poverty, and promote agricultural development. The irrational use of water resources by farmers and their lack of awareness of the importance of the resource is why water is wasted and lost in the fields (Farhan, A.C., K. Alaa, A. M. R. Mohamed, T. M. Hassanein, Ismail and R. Mohamed 2017). In addition, some cases of pollution occur in one of the production processes during planting, irrigation, harvesting, storage, or in transportation and shipping operations, which cause significant losses in the produced quantity (Alhendi, A.S., A.M. Ali and A.K. Mohammed. 2023). The most dangerous type of pollution affecting this crop is rice contamination with heavy metals due to the use of wastewater during cultivation, which subsequently pollutes the crop (Chyad, A.A., A.M. Saeed and A.S. Alhendi. 2022). Or it is contaminated with fungi during the harvesting, storage, or transportation process, or before and after the manufacturing process (Habib, K.R., S.A. Beloved and K.A. Al-Obaidi. 2005). In addition, there is a decline in the efficiency of agricultural companies contributing to the agricultural production and

marketing process due to the critical financial situation and their inability to fulfill their obligations. The economic efficiency of farmers decreases due to the family farm style, which leads to inefficiency of available resources, which decreases production while increasing costs. That is, there is no balanced distribution of investment allocations between economic sectors (Hassan, T.K. and A.F. Ahmed. 2023). Add to that the presence of social and economic variables that have a direct and indirect impact on farmers' response to government legislation and laws related to the production, regulation, and marketing of the rice crop. The role of local administrations in planning and managing services has declined, which affects negatively the development process (Hasan, A.M. and S.M. Hamid. 2023). This greatly affected the amount of rice produced, that caused a decline in the area allocated for agriculture and a decline in production, compared to an increase in the rate of availability for consumption, which was accompanied by a greater increase in the size of the population. The development of the rice crop faces many human and natural determinants that have affected food, political, and economic security. This matter may expose the state to food dependency, which affects the state's sovereignty (Al-Bedry, M. and E. Mizher. 2023). Therefore, it is necessary to find ways to increase production by introducing new varieties with high productivity or discovering new varieties by producing a unique type of crop genotype (Al-kazaz, A.K. 2014),( Hassan, N.H. 2018). Table (1) shows the production of the crop, which covers a small percentage of the country's need, about (15%) of the population's need, due to increased consumption as a result of an increase in the population. On the other hand, there is a low increase in production, so Iraq needs to import to secure its needs of the crop.

**Table 1. Production and Imports of Rice in Iraq during (2000-2021)**

Years	Production (1000 ton)	Imports (1000 ton)	Consumption (1000 ton)	Population (1000 person)	Per Capita Consumption (KG)	Border Price (1000 US \$)
2000	124	1200	1313	20473	64.15	305000
2001	49	1278	1316	21091	62.40	323773
2002	193	1162	1354	21730	62.29	340000
2003	81	433	512	22251	23.00	159011
2004	250	651	901	23068	39.05	173493
2005	308	830	1138	23768	47.87	290154
2006	363	1329	1692	24488	69.09	465623
2007	392	735	1127	25230	44.66	304273
2008	248	1051	1299	27110	47.91	588670
2009	173	1099	1272	27289	46.61	569802
2010	155	1123	1278	27572	46.34	586720
2011	235	1122	1357	28242	48.04	640038
2012	361	1384	1745	29076	60.01	940730
2013	451	1317	1768	30122	58.69	957321
2014	403	930	1333	30604	43.55	451138
2015	109	991	1100	31393	35.03	739326
2016	181	923	1104	32400	34.06	582605
2017	265	1272	1537	33088	46.45	710522
2018	182	1291	1473	33725	43.67	94616
2019	574	1003	1577	34304	45.96	959589
2020	464	1256	1720	35212	48.84	774799
2021	422	2131	2553	41190	61.97	887027
average	271.9	1114.1	1384.9	.....	49.08	577081

Source: Per-capita consumption was calculated by researchers according to data from Iraqi Ministry of Planning / Central Organization of statistics, and the date from Food and Agriculture Organization of the United Nations (FAO).

**Multi-equation inverse residual demand model for rice:** Econometric multi-equation models were estimated for the residual demand function for Iraq's import of rice, including four elasticities for the residual demand for the most important competing countries exporting rice to the Iraqi market, which are United States of America, Thailand, Pakistan, and India. The study adopted the logarithmic formula in estimation to obtain direct values for the elasticities of residual demand. The econometric method of estimation was seemingly unrelated regression (sur). It was developed by the economist Arnold Zellner, and it is one of the most successful and efficient methods for determining regressions (Alkhamisi, M.A. and G. Shukur. 2008). The sur method is based on estimating the parameters of all estimated equations simultaneously. The inverse residual demand model may be specified as follows:

$$\ln P_{ex} = a + b_1 \ln q_{ex} + d \ln \left( \frac{k}{cpi} \right) + \sum_{i=1}^n b_2 \ln e_r + e_i$$

Where:

P: represents the import price of a ton of rice in US dollars from each exporting country to the Iraqi market.

Q: The quantity of rice imported in thousands of tons from each country competing to export rice to the Iraqi market.

K: Iraqi national income.

Cpi: represents the consumer price index in Iraq with a base year (2007=100)

Er: represents the exchange rate of the currency of the exporting countries in Iraqi dinars.

If the inverse elasticity of demand is equal to zero, this indicates a perfectly competitive market, i.e., statistically insignificant. If the elasticity is different from zero, this indicates the presence of market power, i.e., statistically significant, and the absolute value of the

remaining elasticity of demand indicates the extent of the ability to raise prices more than marginal cost.

### RESULTS AND DISCUSSION

Table (2) shows the estimated parameters of the inverse residual demand model for the most important countries exporting to the Iraqi market during the period (2005-2021). It is obvious that the values of the elasticities of residual demand for the competing countries were statistically significant at level of 0.05 for each of India, Thailand and Pakistan, and at 0.01 for the United States. This shows that each of the countries competing in rice exports has market power within the Iraqi market. The remaining elasticity of demand was about (-0.06, -0.06, 0.02, and 1.14) for India, Pakistan, Thailand, and the United States, respectively. The signal was identical to the economic logic for both Pakistan and India. When the exported quantity of Indian and Pakistani rice increased by 1% and 5%, the price will rise by 0.06 due to the imposition of higher prices by Indian exporters due to the high demand from Iraq and other countries, compared to the decline in purchasing power for Pakistani rice

in Iraq due to the high costs of supplying rice to the Iraqi market. The signal was contrary to the economic logic of Thailand and the United States because of the increase in the imported quantity from Thailand and America by 1%, which led to an increase in the price by 0.02 and 1.14 for each of Thailand and the United States, respectively. Thailand imposes low prices in its export of rice, which made Iraq is one of the largest importers of Thai rice regardless of the quality of the crop, in addition to the low exchange rate of the Thai baht (Thai currency). Approximately 40 thousand tons of Thai rice was supplied per month to the Iraqi market. From the other hand, Iraq ranked eighth in purchasing American rice in order to achieve food security and food support programs, as it imports approximately 200 thousand tons of rice from the United States annually according to a memorandum of understanding between the two countries and the decline of the dollar against the dinar. The exchange rate of the Iraqi dinar was decreased by a greater percentage than the decline of the US dollar.

**Table 2. Estimation results of the system of equations**

<b>System: SYS01</b>				
<b>Estimation Method: Seemingly Unrelated Regression</b>				
<b>Date: 04/26/24 Time: 14:05</b>				
<b>Sample: 1 17</b>				
<b>Included observations: 17</b>				
<b>Total system (balanced) observations 68</b>				
<b>Linear estimation after one-step weighting matrix</b>				
	<b>Coefficient</b>	<b>Std. Error</b>	<b>t-Statistic</b>	<b>Prob.</b>
C(1)	926.6643	880.5759	1.052339	0.2990
C(2)	-0.068256	0.030800	-2.216118	0.0324
C(3)	0.614669	0.358313	1.715453	0.0940
C(4)	735.0510	709.2995	1.036305	0.3063
C(5)	-736.2674	710.8881	-1.035701	0.3066
C(6)	0.084580	0.479301	0.176464	0.8608
C(7)	-2.145838	2.308605	-0.929496	0.3582
C(8)	305.7611	679.1467	0.450214	0.6550
C(9)	-0.061824	0.031047	-1.991301	0.0533
C(10)	0.570779	0.192574	2.963940	0.0051
C(11)	-253.4492	547.9970	-0.462501	0.6462
C(12)	-0.110980	0.316666	-0.350462	0.7278
C(13)	1.805407	1.550506	1.164399	0.2512
C(14)	250.7985	546.7420	0.458715	0.6489
C(15)	-645.3031	379.7093	-1.699466	0.0970
C(16)	0.029973	0.016999	1.763287	0.0855
C(17)	0.716673	0.121506	5.898237	0.0000
C(18)	-0.226603	0.200416	-1.130662	0.2649
C(19)	-0.288379	0.904343	-0.318882	0.7515
C(20)	-512.9232	305.4644	-1.679159	0.1009
C(21)	512.8909	306.1535	1.675274	0.1017
C(22)	-5341.522	4220.061	-1.265745	0.2129
C(23)	1.148720	0.146005	7.867702	0.0000
C(24)	2.670574	1.452399	1.838733	0.0734
C(25)	-14.94083	11.10869	-1.344968	0.1862
C(26)	-4304.135	3398.418	-1.266511	0.2127
C(27)	4312.378	3405.894	1.266152	0.2128
C(28)	1.221756	2.298668	0.531506	0.5980
<b>Determinant residual covariance</b>		2.15E-06		
<b>Equation: LVIND = C(1)+C(2)*LQIND+C(3)*LKCPi+C(4)*LERIND+C(5)*LERBAK+C(6)*LERTHI+C(7)*LERUSA</b>				
<b>Observations: 17</b>				
<b>R-squared</b>	<b>0.658240</b>	<b>Mean dependent var</b>	<b>-0.164584</b>	
<b>Adjusted R-squared</b>	<b>0.453184</b>	<b>S.D. dependent var</b>	<b>0.350222</b>	
<b>S.E. of regression</b>	<b>0.258979</b>	<b>Sum squared resid</b>	<b>0.670701</b>	
<b>Durbin-Watson stat</b>	<b>1.816510</b>			
<b>Equation: LVPAK = C(8)+C(9)*LQPAK+C(10)*LKCPi+C(11)*LERBAK+C(12)*LERTHI+C(13)*LERUSA+C(14)*LERIND</b>				
<b>Observations: 17</b>				
<b>R-squared</b>	<b>0.740754</b>	<b>Mean dependent var</b>	<b>-0.669767</b>	
<b>Adjusted R-squared</b>	<b>0.585206</b>	<b>S.D. dependent var</b>	<b>0.254918</b>	
<b>S.E. of regression</b>	<b>0.164178</b>	<b>Sum squared resid</b>	<b>0.269546</b>	
<b>Durbin-Watson stat</b>	<b>1.693619</b>			
<b>Equation: LVTHI = C(15)+C(16)*LQTHI+C(17)*LKCPi+C(18)*LERTHI+C(19)*LERUSA+C(20)*LERIND+C(21)*LERBAK</b>				
<b>Observations: 17</b>				
<b>R-squared</b>	<b>0.805929</b>	<b>Mean dependent var</b>	<b>-0.874935</b>	
<b>Adjusted R-squared</b>	<b>0.689486</b>	<b>S.D. dependent var</b>	<b>0.183772</b>	
<b>S.E. of regression</b>	<b>0.102405</b>	<b>Sum squared resid</b>	<b>0.104868</b>	
<b>Durbin-Watson stat</b>	<b>1.851182</b>			
<b>Equation: LVUSA = C(22)+C(23)*LQUSA+C(24)*LKCPi+C(25)*LERUSA+C(26)*LERIND+C(27)*LERBAK+C(28)*LERTHI</b>				
<b>Observations: 17</b>				
<b>R-squared</b>	<b>0.796716</b>	<b>Mean dependent var</b>	<b>0.060943</b>	
<b>Adjusted R-squared</b>	<b>0.674745</b>	<b>S.D. dependent var</b>	<b>2.186442</b>	
<b>S.E. of regression</b>	<b>1.246952</b>	<b>Sum squared resid</b>	<b>15.54890</b>	
<b>Durbin-Watson stat</b>	<b>2.346438</b>			

Source: The estimation was done by researchers using Eviews12

Table (3) illustrates market power for all competing countries, where the average market share for Thailand, India, Pakistan, and the United States was about (34.67, 10.35, 18.10, and 3.06) thousand dollars. Thailand

had a high market share compared to other competing countries. This indicates that Thailand has a market power that restricts the market power of countries competing to export rice to Iraq.

**Table 3. Average market share in Iraqi imports market of rice**

Country	THI	IND	PAK	USA
Average	34.67%	10.35%	18.10%	3.06%

Source: Calculated by researchers

USA: United States of America, IND: India, PAK: Pakistan, THI: Thailand.

The results of price competitiveness are presented in table (4). There is

competitiveness between countries that have price competitiveness among themselves, and that the consumer prefers these goods according to factors other than price.

**Table 4. Price competition among exporters to Iraq market of rice**

CM	USA/ PAK	PAK/ USA	USA/ THI	THI/ USA	USA/ IND	IND/ USA	IND/ THI	THI/ IND	IND/ PAK	PAK/ IND	THI/ PAK	PAK/ THI
average	1.29	0.83	0.64	2.24	0.60	2.41	1.09	1.28	2.71	0.44	2.8	0.38

Source: Calculated by researchers

CM: price competitiveness.

USA: United States of America, IND: India, PAK: Pakistan, THI: Thailand.

### Test for econometric problems

**1- Autocorrelation:** Time series data are vulnerable to the problem of autocorrelation, and this problem is a violation of regression assumptions. Therefore, Cochrane-Orcutt procedure was used to solve the autocorrelation problem, and the model is obtained as follows:

$$Y'_t = \lambda y_t - \phi y_{t-1}$$

$$Y'_t = \alpha_0 + \alpha_1 x_t + \varepsilon_t - \phi(\alpha_0 + \alpha_1 x_{t-1} + \varepsilon_{t-1})$$

$$Y'_t = \alpha_0(1 - \phi) + \alpha_1(x_t - \phi x_{t-1}) + \varepsilon_t - \phi \varepsilon_{t-1}$$

$$Y'_t = \alpha'_0 + \alpha_1 x'_t + \beta_t$$

The outputs of the first analysis, with the corresponding tabular values of Durbin-Watson test, were as follows:

India's equation (DW=1.81) compared to (dl=0.55 and du=2.32).

Pakistan's equation (DW=1.69) compared to (dL=0.55 and du=2.32).

Thailand's equation (DW=1.85) compared to (dL=0.55 and du=2.32).

US equation (DW=2.34) compared to (dL=0.55 and du=2.32).

In all cases, the statistics fall into areas of inconclusive decision, and the result was indeterminate as to whether there was autocorrelation or vice versa. The presence of results in this region may be due to the problem of multicollinearity between the independent variables. If it is confirmed that the model is free of the problem of multicollinearity between the independent variables, we can make a decision that the model is free of econometric problems. To confirm further, the Cochrane-Orcutt procedure was conducted, and when comparing the two values of Durbin-Watson test statistic, we notice that the results of the first analysis are much better, and this indicates that the model is free of the problem of autocorrelation.

**Table 5. Cochrane-Orcutt procedure results**

Equation: $LVIND = C(1)+C(2)*LQIND+C(3)*LKCPI+C(4)*LERIND+C(5)*LERBAK+C(6)*LERTHI+C(7)*LERUSA+(-0.014101)*(LVIND(-1)-C(1)-C(2)*LQIND(-1)-C(3)*LKCPI(-1)-C(4)*LERIND(-1)-C(5)*LERBAK(-1)-C(6)*LERTHI(-1)-C(7)*LERUSA(-1))$			
Observations: 16			
R-squared	0.718141	Mean dependent var	-0.151346
Adjusted R-squared	0.530234	S.D. dependent var	0.357289
S.E. of regression	0.244884	Sum squared resid	0.539712
Durbin-Watson stat	1.526140		
Equation: $LVPAK = C(8)+C(9)*LQPAK+C(10)*LKCPI+C(11)*LERBAK+C(12)*LERTHI+C(13)*LERUSA+C(14)*LERIND+(0.113288)*(LVPAK(-1)-C(8)-C(9)*LQPAK(-1)-C(10)*LKCPI(-1)-C(11)*LERBAK(-1)-C(12)*LERTHI(-1)-C(13)*LERUSA(-1)-C(14)*LERIND(-1))$			
Observations: 16			
R-squared	0.782520	Mean dependent var	-0.655840
Adjusted R-squared	0.637533	S.D. dependent var	0.256511
S.E. of regression	0.154433	Sum squared resid	0.214646
Durbin-Watson stat	1.569505		
Equation: $LVTHI = C(15)+C(16)*LQTHI+C(17)*LKCPI+C(18)*LERTHI+C(19)*LERUSA+C(20)*LERIND+C(21)*LERBAK+(-0.012745)*(LVTHI(-1)-C(15)-C(16)*LQTHI(-1)-C(17)*LKCPI(-1)-C(18)*LERTHI(-1)-C(19)*LERUSA(-1)-C(20)*LERIND(-1)-C(21)*LERBAK(-1))$			
Observations: 16			
R-squared	0.722559	Mean dependent var	-0.850876
Adjusted R-squared	0.537598	S.D. dependent var	0.159774
S.E. of regression	0.108646	Sum squared resid	0.106236
Durbin-Watson stat	1.707071		
Equation: $LVUSA = C(22)+C(23)*LQUSA+C(24)*LKCPI+C(25)*LERUSA+C(26)*LERIND+C(27)*LERBAK+C(28)*LERTHI+(-0.189226)*(LVUSA(-1)-C(22)-C(23)*LQUSA(-1)-C(24)*LKCPI(-1)-C(25)*LERUSA(-1)-C(26)*LERIND(-1)-C(27)*LERBAK(-1)-C(28)*LERTHI(-1))$			
Observations: 16			
R-squared	0.807153	Mean dependent var	0.134358
Adjusted R-squared	0.678589	S.D. dependent var	2.236403
S.E. of regression	1.267887	Sum squared resid	14.46783
Durbin-Watson stat	2.205738		

Source: The estimation was done by researchers using Eviews12

**2- Multicollinearity:** The Variance Inflation Factor (VIF) test was adopted to determine if there is a multiple linear correlation for the explanatory variables. If the values of the estimators are less than 10, this indicates that there is no multicollinearity problem, and the results are free of it for all estimated models, since the values were less than 10.

**Table 6. Test for multicollinearity (Thailand)**

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	253600.8	4.27E+08	NA
LQTHI	0.000574	160.1205	1.674566
LKCPI	0.025412	8436.376	1.852204
LERTHI	0.070147	1430.688	2.779705
LERUSA	1.396267	119005.4	16.17642
LERBAK	164821.0	8.67E+09	2500965.
LERIND	164077.1	5.22E+09	2491983.

Source: The estimation was done by researchers using Eviews12

**Table 7. Test for multicollinearity (USA)**

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	30295635	3.31E+08	NA
LQUSA	0.038922	70.80611	1.036754
LKCPI	3.586546	7731.231	1.697388
LERUSA	209.8656	116141.2	15.78706
LERTHI	8.994859	1191.180	2.314358
LERBAK	19733436	6.74E+09	1944214.
LERIND	19646867	4.06E+09	1937477.

Source: The estimation was done by researchers using Eviews12

**Table 8. Test for multicollinearity (Pakistan)**

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	811671.6	5.14E+08	NA
LQPAK	0.001808	115.7838	1.897770
LKCPI	0.063172	7886.721	1.731520
LERBAK	528438.7	1.05E+10	3015327.
LERIND	526013.7	6.30E+09	3004270.
LERUSA	4.136983	132595.4	18.02363
LERTHI	0.172361	1321.971	2.568466

Source: The estimation was done by researchers using Eviews12

**Table 9. Test for multicollinearity (India)**

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	1324573.	3.36E+08	NA
LQIND	0.002040	78.02301	2.445415
LKCPI	0.235158	11750.58	2.579838
LERIND	859501.0	4.12E+09	1964799.
LERBAK	863377.3	6.84E+09	1971835.
LERUSA	9.075592	116425.4	15.82572
LERTHI	0.393239	1207.168	2.345425

Source: The estimation was done by researchers using Eviews12

## CONCLUSION

The research determined the market power of rice exporters to the Iraqi market from four countries, including Thailand, India, USA and Pakistan. The inverse residual demand methodology was used to test the existence and extent of the market power of these countries. The results revealed the existence of imperfect competition between countries supplying rice to the Iraqi market, as the results of the SUR test were statistically significant, meaning that all exporting countries have market power within the Iraqi market. The demand for Thai rice has increased due to the decline of the Thai baht currency. In addition, it is comparable to American rice and can be mixed with Indian and Pakistani rice. American rice has become a major commodity in the Iraqi market due to the quality of the crop. Despite the high price, Iraq has become a major importer of American

rice. Both Pakistan and India had great market power in spite the high prices, as prices rise depending on the type and size of rice, but there is a preference by individuals to buy Indian and Pakistani rice. As a result, Thai rice is sold via the ration card and replaced with Indian rice.

## ACKNOWLEDGEMENT

### CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

### AUTHOR/S DECLARATION

We confirm that all Figures and Tables in the manuscript are original to us. Additionally, any Figures and images that do not belong to us have been incorporated with the required permissions for re-publication, which are included with the manuscript.

Author/s signature on Ethical Approval Statement.

Ethical Clearance and Animal welfare

Funds:

#### AUTHOR'S CONTRIBUTION STATEMENT

Awf A. Alsaad was responsible for designing the study. The analysis was conducted by Amna Aqeel Majeed. Both authors composed the manuscript.

#### JOURNAL DECLARATION

The Second author (**Awf A. Alsaad**) serves as an editor for Iraqi Journal of Agricultural Sciences but was not involved in the peer review process of this manuscript beyond their role as an author. The authors declare no other conflict of interest.

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تقدير القوة السوقية لمُصدري الرز الى العراق خلال المدة (2005–2021)

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المستخلص

هدفت الدراسة الى قياس وتحليل القوة السوقية لمعرفة مدى سيطرة بلد مُصدر معين على سوق الرز العراقي من خلال نتائج تحليل الطلب المتبقي على الأصناف المختلفة للرز. شملت الدراسة اربع دول وهي تايلند والهند وباكستان والولايات المتحدة الامريكية وهي الدول الأهم في تصدير الرز. تم قياس مرونة الطلب المتبقي العكسي لهذه الدول خلال مدة الدراسة (2005–2021). وقد توصلت الدراسة الى وجود قوة سوقية لدى البلدان الموردة للرز الى السوق العراقي، إذ تتمتع تايلند بقوة سوقية اكبر من الولايات المتحدة بسبب انخفاض أسعار صادراتها وانخفاض قيمة عملتها المحلية. من جانب اخر، كانت هناك تنافسية بين باكستان والهند في سوق الرز العراقي. اوصت الدراسة بضرورة تدخل الحكومة من اجل دعم المزارعين لتحسين الإنتاجية من اجل تعزيز ورفع مستوى الامن الغذائي من اجل تقليل الاعتماد على الاستيراد.

الكلمات المفتاحية: التنافسية، سوق الاستيرادات، الطلب المتبقي، الانحدار غير المرتبط ظاهرياً، نظام المعادلات.

\*جزء من رسالة الماجستير للباحث الاول