



Regional Trade Arrangements and Optimal Tariff Calculation according to Armington Hypothesis

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Abstract

Disciplined international competition and formal agreements worldwide would potentially prevent the mistakes of domestic policies, thereby resulting in more stable economic growth. This article aims to investigate the results of concluding agreements between the regional countries, especially regarding the Iraqi market as a target market, using a Computable General Equilibrium (CGE) Model. To this end, the model parameters were calibrated, and then different aspects of concluding the agreement were examined. The welfare effects were investigated by estimating the competitive equilibrium model. Next, the simulation results were analyzed according to the non-cooperative Nash equilibrium model by considering the interaction of countries and the methods of weighted coefficients and LP-Metric using GAMS software. The results indicate that concluding a regional agreement, in terms of welfare according to the general equilibrium model using the Armington hypothesis, would have the best possible result when the agreement is concluded between Iran, Turkey, and Iraq. The results of the scenario using the Nash tariff war to create trade rules with non-member countries also revealed that the welfare situation of countries is far worse compared to the competitive equilibrium. It was also found that the welfare level achieved by concluding an agreement between all the studied countries was as low as possible compared to other scenarios of the present study.

Keywords: Armington elasticity of substitution, general equilibrium model, non-cooperative equilibrium, Nash equilibrium, regional trade agreement.

JEL Classification: C68, F10, F13.

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Introduction

Many governments have trade and economic interactions with each other. A regional trade agreement is now a prominent feature of the world trade system. Such an agreement has become an important tool in trade policy for almost all WTO members and strengthens relations between countries by reducing trade barriers (Dicaprio et al., 2017). However, there are always concerns in international trade that a tendency for regional trade agreements could have long-term destructive effects on the liberalization of foreign trade and the multilateral trade system. In this context, the key question is whether the conclusion of the trade agreement will improve the situation of member countries. According to Viner (1950), trade agreements do not necessarily improve the world's welfare. Exclusion of tariffs between members may lead to trade diversion. Such agreements can divert trade from non-member states with which trade may have advantages to relatively inefficient member states. This situation destroys efficient allocation between countries. To solve this problem, some economists propose the theory of natural trading partners. A natural trading partner is defined according to the high trade volume between two or more countries with the shortest geographical distance. According to Krugman (1991) and Summers (1991), making a disproportionate share of world trade between trade blocs, even if there is no preferential trade agreement, means the profits from trade within the blocs are likely to be more than any possible losses from foreign trade diversion.

Despite its complexities and conflicting opinions, globalization has many positive and negative effects on countries. Therefore, in recent decades, governments have used regional trade arrangements to protect the country against shocks and gain a competitive advantage in the global market. According to the World Trade Organization website, the number of regional trade agreements has increased from 22 in 1990 to 297 in 2018 and 568 in 2021. For developing countries like Iran, a regional agreement can be the most effective way to integrate into the global economy. The regional economy will allow manufacturers to access large markets by removing tariff barriers and other customs barriers in the region. Besides, the barriers to transferring capital and technology within the region would be removed.

Johnson (1954) proposed the standard theory of trade agreements that if there is no trade agreement, countries will use tariffs to exercise international market power, and the resulting balance will be a trade war. For all countries, international trade agreements are considered a way to avoid a trade war.

To examine the possibility of concluding a regional trade agreement, we used the traditional models of competitive static equilibrium in this paper. In addition, the non-cooperative Nash equilibrium model was used according to each country's preferred tariff and the rate of tariff in another area determined by intertwined models. Most recently, much of the preferred tariff literature is still based on Johnson (1954) and Gorman (1957). These scholars determined optimal tariffs by one country and the independent response of another country. However, they did not consider how the competing country responded to the tariff. In the model used in this research, the optimal tariffs are calculated by the competition process and then are corrected according to any changes in the tariffs of another country. In the end, equilibrium is achieved when regional optimization behaviors are consistent in all regions. In addition, the total weighted coefficients and LP-Metric methods were used to find the game solution in this model. Then, the consequences of business arrangements were analyzed using both methods and GAMS software.

Iraq is one of the most significant regional markets, with 95% of its consumer goods imported. It also houses a population of around 36 million consumers. Considering its proximity, it is regarded as one of the best markets for Iran. Based on this premise, the Iraqi market is attractive and substantial for nations and with impending reconstruction efforts in the country, the share of countries in this market is expected to increase. However, the pivotal question remains: how can competitors vie in this market? There is fierce competition between China, Iran, and Turkey to gain a larger market share in Iraq since these countries are among the major exporters of goods. Concurrently, the energy market in Iraq holds tremendous allure for investors. Iranian, Russian, and Turkish companies compete to establish a presence in this market, presenting long-term challenges for Iranian firms. Experts posit that these challenges become more pronounced when recognizing that Turkey, a staunch competitor to Iran for the Iraqi market, strives to facilitate its exports to this market through incentives and motivators. Nonetheless, Iran and Turkey's market shares continue to contend closely. Hence, the necessity for cooperation between Iran and Turkey to secure a superior position in the Iraqi market and harness its profitable potential becomes paramount. Adopting a novel approach to trade relations with Iraq and updating export processes and trends could consolidate and fortify trade relations between Iran and Iraq. Failure to do so could result in missed opportunities in this market. Considering the imperative of coordinated action and mutual interests among nations for trade programs, this article delves into the potential for amicable trade actions concerning Iraq. The analysis is

grounded in game theory and focuses on Iran and Turkey as neighboring countries that play a significant role in Iraq's trade exchanges.

In this study, Iraq is considered as a target market, while Iran, Turkey, and Russia want to find the best possible way to reach a regional trade agreement with this country. On the other hand, Iraq seeks the maximum welfare resulting from the conclusion of the agreement with these countries.

The remainder of this article is organized as follows. Section 2 presents the theoretical foundations of the regional trade agreement. Section 3 reviews the related domestic and foreign studies. Section 4 examines the models and analysis. Section 5 presents the simulation results and sensitivity analysis. Finally, Section 6 provides concluding remarks.

Theoretical Foundations

General Equilibrium Model According to Armington Theory

According to the Armington (1969) hypothesis, domestic and foreign goods are distinguished because of the place of their production. As a result, it has become one of the main reasons for empirical trade studies. This hypothesis is usually used in econometric and simulation models to model import demand and evaluate the effects of different trade policy options. Trefler (1995) used the Armington hypothesis and found its efficiency in explaining why trade between countries is much less than predicted in traditional trade theory. This hypothesis explains what Trefler describes as the rate of decline in trade over traditional trade theory and answers the questions about the utility factors of consumers that lead to a trade reduction. In particular, the degree of substitution between domestic and imported goods may only be due to economic reasons such as product and industry characteristics or the political variables that can increase bias toward domestic goods. In addition, it explains the difference between domestic and foreign goods.

Using economic models to assess changes in international trade policy generally requires turning policy changes into price effects. The trade policy change on individual variables depends on the shock and behavioral relationships in the economy. In policy analysis in the economic models, these behavioral relationships are mainly as elasticities that show the reaction of one set of variables to a change in another set. For instance, trade policy can affect the price of imported goods compared to domestically produced goods. Consequently, there will be a key relationship for analyzing the rate of substitution model between imported and domestic goods. This relationship is commonly known as Armington elasticity (McDaniel and Balistreri, 2003). In the Armington hypothesis, a country may

simultaneously export and import particular goods. Thus, certain assumptions about the substitution rate of various imported goods in a country are necessary to make the general equilibrium modeling process more precise.

Armington solved this problem by stating the assumption that goods are not homogeneous between different countries and can replace each other. In other words, the Armington models determine a constant elasticity of substitution (CES) for domestic and imported goods by optimizing consumption for the consumer.

The elasticity of substitution between two products depends on the degree of product differentiation. The greater the differences, the lower the elasticity of substitution between products. However, product differentiation is not only related to the actual physical differences between goods. Instead, identical physical goods may be distinguished by availability, ease of purchase, after-sales service, or even consumers' perception of the inherently invisible quality (Blonigen and Wilson, 1999). These factors, which are not related to physical properties, may have a significant impact on product differentiation and, consequently, the elasticity of substitution between domestic and foreign goods. These factors indicate greater differentiation. Also, if domestic goods are systematically better than imported goods in terms of the above factors, the tendency to consume domestic goods is higher. This is because imports do not necessarily cover the costs and risks of additional transactions, from customs documents to exchange-rate risk, disruptions in the provision of resources, shipment delays, and possibly fewer resources for after-sales service from a foreign supplier (Blonigen and Wilson, 1999). These factors differentiate similar goods such that customers will prefer domestic goods.

The position of foreign companies in the host market may affect substitution patterns. The empirical literature has examined the activities of multinational corporations and their impact on trade models. These companies may blur the distinction between imported and domestic goods and reduce product differentiation. Accordingly, some activities by foreign companies in the importing country may lower the transaction costs of imported goods and increase the elasticity of substitution between domestic and imported goods.

Some factors underlying initial consumer preferences may determine the effects of consumer tendency for domestic goods and imperfect substitution between domestic and foreign goods. These economic factors, which influence substitution patterns, significantly affect industrial sectors. Therefore, each country demands not only the goods it produces but also similar goods from other countries because consumers perceive possible differences among goods produced in different regions.

Imagine a world consisting of three countries: country A, country B, the future partner, and country C, the other countries. Each country produces only one good and exports part of its output to pay for the cost of importing the other two goods. When the price of each good is converted into currency, the budget constraint of country A can be expressed by Equation (1):

$$E(1, 1 + t_B, 1 + t_C, W) = R(1, 1 + t_B, 1 + t_C, \bar{V}) + t_B M_B + t_C M_C \quad (1)$$

where E is a cost function for country A and R is a function of income (revenue from the sale of any manufactured goods); W represents the welfare of country A, \bar{V} denotes the constant factor used in production in country A; and t_B , t_C , M_B , and M_C indicate the import tariffs from countries B and C and the imports quantity from those countries, respectively.

Equation (1) shows the budget, expenditure, cost, and revenue constraints in traditional business theory (Krishna, 2003). According to the Armington hypothesis, each country produces only one good, and supply is fixed. This means that part of the income function is zero with respect to prices. To examine the preferential tariffs imposed by country A on country B, the partial derivative of E in Equation (1) with respect to the domestic price of good i is used to obtain Equation (2):

$$E_B dt_B + E_W dW = t_B dM_B + M_B dt_B + \bar{t}_C dM_C \quad (2)$$

where E_i represents the payments to consume goods i . thus, $E_B = M_B$, and:

$$E_W dW = t_B dM_B + \bar{t}_C dM_C \quad (3)$$

When $E_W > 0$, according to Equation (3), imports from the partner country and the other countries should be increased to improve welfare. If the import is increased from the partner country, $dM_B > 0$, which means trading. On the other hand, if imports from other countries should decrease, $dM_C < 0$, which indicates a trade diversion and reduced welfare (Krishna, 2003). To make a connection in Equation (3), note that compensated functions of import demand (i.e., M_B and M_C) are a function of price and welfare. Therefore, they can be expressed as Equations (4) and (5):

$$M_B = M_B(1, 1 + t_B, 1 + \bar{t}_C, W) \quad (4)$$

$$M_C = M_C(1, 1 + t_B, 1 + \bar{t}_C, W) \quad (5)$$

Equations (6) and (7) are obtained by differentiating the above equations:

$$dM_B = M_{BB} dt_B + M_{BW} dW \quad (6)$$

$$dM_C = M_{CB} dt_B + M_{CW} dW \quad (7)$$

Substituting (6) and (7) in (3) will result in Equation (8):

$$(E_W - t_B M_{BW} - \bar{t}_C M_{CW})dW = (t_B M_{BB} + \bar{t}_C M_{CB})dt_B \quad (8)$$

Since E is one degree homogeneous in terms of price, E_W is one degree homogeneous in terms of price. Using Euler's theorem gives:

$$E_W = E_{AW} + (1 + t_B)E_{BW} + (1 + t_C)E_{CW} \quad (9)$$

Replacing Equation (9) with Equation (8) will result in welfare as achieved by McMillan and McCann (1981):

$$HdW = (t_B M_{BB} + t_C M_{CB})dt_B \quad (10)$$

From Equations (8) and (9), H is measured as follows:

$$H = E_{AW} + E_{BW} + E_{CW} = \left[\frac{\partial(E_A + E_B + E_C)}{\partial I} \right] E_W \quad (11)$$

where $\frac{\partial E_i}{\partial I}$ indicates the increased consumption of goods i with the increased one unit of income (by keeping prices constant). Given that E_W is the reverse of the gross profit of income, H represents the total increase in the actual value of the consumption basket (the value of the consumption basket at a global price) related to the increased welfare level (Krishna, 2003). According to Dixit and Norman (1980), HdW represents a change in real income. Therefore, the right-hand side of Equation (10) can be interpreted as the actual revenue change related to the dt_B tariff reduction. If all goods are normal, $\frac{\partial E_i}{\partial I} > 0$ for all goods, suggesting that H is also positive.

According to Equation (10), welfare improves if imports from the partner country substitute for domestic production and satisfy import demand from the rest of the world. However, even if production in other countries and production in the partner country are substitutes, welfare may improve. According to Kemp and Wan (1976), if foreign tariffs are such that the customs union does not affect trade with nonmembers and external trade remains stable, any additional trade among members will increase trade creation without harming countries outside the union. In other words, welfare will improve under such agreements in this case. However, this theory has not been widely applicable because foreign tariffs are often subject to political restrictions, and the terms of trade are unstable. Wonnacott and Lutz (1989) and Summers et al. (1991), although they opposed the Vinerian theory, argued that if regional trade agreements exist between natural trading partners, the gains from trade outweigh the costs of trade diversion for members.

General Welfare Equilibrium Model Based on Competitive and Non-cooperative Nash Equilibrium

In this research model, which is based on Ghosh (2002), only consumption is considered. In addition, regional products are assumed to be differentiated (Armington hypothesis). Therefore, in each region, only one good is produced, consumed, and exported. The countries in this study are divided into two regions: members of the agreement and nonmembers. Consumers in region j use goods from their region and composite goods from the other region. Here, we consider single goods in each region in a fixed source. Also, $j = 1, \dots, K$ represents the number of regions, and S^j is the endowment level in the region j . The components of the general equilibrium welfare model include preferences, regional trade policy, competitive equilibrium, and noncooperative Nash equilibrium, which are discussed below.

Preferences

Demand in region j is determined by maximizing utility subject to regional budget constraints. The Armington function is a constant elasticity of substitution (CES) function. Therefore, for each region, a representative consumer is considered, and the CES structure is used for it:

$$U^j = (\alpha_D^j D_j^{\sigma_j-1/\sigma_j} + \alpha_C^j C_j^{\sigma_j-1/\sigma_j})^{\sigma_j/\sigma_j-1}, \quad (j = 1, \dots, K) \quad (12)$$

where U^j indicates desirability level. D_j and C_j denote quantities of domestic goods and imported compound goods consumed by region j , respectively; α_D^j and α_C^j indicate share parameters in region j to domestic and imported compound goods, respectively, and σ_j indicates the high-level elasticity of substitution of the CES structure in region j .

If M_i^j is the rate of imports of region j from region i . Here, it is assumed that there is only one produced goods that is both consumed domestically and used for export to use Argminton hypothesized in the model. Hence, the total imports in region j , C_j , can be considered as a compound CES function of imports of M_i^j . In other words,

$$C_j = \left[\sum_{i \neq j} \beta_i^j M_i^j \lambda_j^{-1/\lambda_j} \right]^{\lambda_j/\lambda_j-1}, \quad (j = 1, \dots, K) \quad (13)$$

where β_i^j shows CES share parameter of imports of region j from region i , and λ_j indicates a low level of CES elasticity of substitution in region j . Tariffs affect demand through the increased price of imported goods. Tariffs also affect revenue and increase government revenue.

Regional Trade Policy

Each region earns money using regionally discriminatory tariffs, t_i^j , including the import tariff rate by region j from region i . Revenue from the tariffs is defined as follows:

$$R_j = \sum_i t_i^j P_i M_i^j \quad (14)$$

R_j indicates the total tariff revenue in region j and P_i indicates the world price of goods i .

Competitive Balance

It is assumed that the agreement members have the same initial tariff as other non-member countries. Accordingly, for the tariff rate given in all regions, the competitive equilibrium for the model is measured using the GAMS software.

In other words, if the revenue of region j , I^j , is according to Equation (15), the tariff revenue in region j , R^j , is measured by Equation (16):

$$I^j = P_j S^j + R^j \quad (15)$$

$$R^j = \sum_{i \neq j} t_i^j P_i M_i^j \quad (16)$$

Since each region in the model has a constant supply of a distinct good, the supply of exportable products by each region is purely inelastic. In other words, the regional supply curves in the model are determined by the initial assets and consumer preferences. Therefore, the representative consumer in each region consumes goods produced domestically and goods imported from other regions. Thus, domestic demand in each region is as follows:

$$D_j = \alpha_D^j I^j / \left[(\alpha_D^j)^{\sigma_j} P_j^{1-\sigma_j} + (\alpha_C^j)^{\sigma_j} (P_j^M)^{1-\sigma_j} \right] P_j^{\sigma_j} \quad (17)$$

where P_j^M is the compound import price in region j , which is measured by Equation (18):

$$P_j^M = \left[\sum_{i \neq j} (\beta_i^j)^{\lambda_j} [(1 + t_i^j) P_i]^{(1-\lambda_j)} \right]^{1/(1-\lambda_j)} \quad (18)$$

When there are exports from region j , X_j is measured according to Equation (19).

$$X_j = S^j - D_j \quad (19)$$

Also, when there is a demand of region j for the compound regional import, C_j is measured by Equation (20).

$$C_j = \frac{\alpha_c^j \sigma_j I^j}{\left[(\alpha_D^j)^{\sigma_j} P_j^{1-\sigma_j} + (\alpha_C^j)^{\sigma_j} (P_j^M)^{1-\sigma_j} \right] (P_j^M)^{\sigma_j}} \quad (20)$$

The demand of region j for imports from region i is as follows:

$$M_i^j = \frac{(\beta_i^j)^{\lambda_j} (P_j^M C_j)}{\left[((1 + t_i^j) P_i)^{\lambda_j} \left[\sum_{i \neq j} (\beta_i^j)^{\lambda_j} [(1 + t_i^j) P_i]^{(1-\lambda_j)} \right] \right]} \quad (21)$$

Total demand for exports from each region l is measured by Equation (22):

$$T_l = \sum_{j \neq l} M_l^j ; \quad \forall l \quad (22)$$

where the price of products of region K , P_i and tariff revenue of region K , R^j is expressed as:

$$T_l = X_l ; \quad \forall j, l \quad (23)$$

Since only the relative price of the product is important, we can choose the price of one of the regional products or normalize the price ($\sum_i P_i = 1$).

Non-cooperative Nash equilibrium

In this section, the tariff rate is determined endogenously and reflects the country's maximum welfare in global competitive equilibria using this structure. The tariff rate for each region is determined by maximizing welfare. Each region has dimensional constraints when measuring the Nash-compensation equilibrium (optimal tariff). The previous literature (Johnson, 1954; Gorman, 1957; Kuga, 1973) used practical, simple forms (i.e., constant elasticity of demand functions) in which there is no optimal regulation of tariffs, and the Nash equilibrium is insignificant. Subsequent literature uses more conventional demand functions in which measuring the Nash equilibrium should be repeated several times. Johnson (1954) limited his discussion of optimal tariffs to proposed levels that ensure each country has the best response regardless of the other country's tariff rate, and provided unit interaction functions and unique Nash results. This article aims to

find a competitive equilibrium in the countries' tariff war using the method used in the article by Huang et al. (2013). According to the model proposed in this study, each country considers the reaction of the rival country as a function of its goal and measures its optimal tariff by repeating the process several times accordingly. Thus, to determine the optimal tariff rate in the countries' response to each other's game, Equation (12) is modified as follows:

$$U(X_i) = \left\{ \sum_{l=1}^2 \alpha_{il}^{1/\sigma_i} X_{il}^{\sigma_i-1/\sigma_i} \right\}^{\sigma_i/\sigma_i-1}, \quad i = 1, 2 \quad (24)$$

Index i represents the number of regions and index l represents the number of examined goods. Also, X_{il} indicates the consumption of goods l in region i . If the tariff rate for both products in the two regions is zero, the resulting equilibrium will be a competitive free trade equilibrium. It is assumed that the trade path is such that if $(X_{11} \geq S_{11}, t_1 \geq 0)$ and $(X_{12} \leq S_{12}, t_1 = 0)$, then region 1 is the importer of goods 1 and the exporter of goods 2, and vice versa. It means that if $(X_{21} \leq S_{21}, t_2 = 0)$ and $(X_{22} \geq S_{22}, t_2 \geq 0)$, then country 2 will be the exporter of goods 2 and the importer of goods 1. Therefore, we can say the price of goods 1 is in this form $P_1(1 + t_1)$ for buyers in Region 1 and P_1 for the sellers of Region 2 and the price of goods 2 is $P_2(1 + t_2)$ for the sellers of country 1 and p_2 for the sellers of country 2.

Expanding the tariff revenue equation gives:

$$\begin{aligned} R_1 &= P_1 t_1 (X_{11} - S_{11}) \\ R_2 &= P_2 t_2 (X_{22} - S_{22}) \end{aligned} \quad (25)$$

Therefore, the income of region j is expressed as Equation (26):

$$\begin{aligned} I_1 &= P_1(1 + t_1)S_{11} + P_2S_{12} + R_1 \\ I_2 &= P_1S_{21} + P_2(1 + t_2)S_{22} + R_2 \end{aligned} \quad (26)$$

In addition, the budgets of the two regions is obtained using Equation (27):

$$\begin{aligned} P_1(1 + t_1)X_{11} + P_2X_{12} &= I_1 \\ P_1X_{21} + P_2(1 + t_2)X_{22} &= I_2 \end{aligned} \quad (27)$$

Accordingly, the extended equations of (17) and (20) will be as Equation (28):

$$\begin{aligned} X_{11} &= \alpha_{11} \{ P_1(1 + t_1)S_{11} + P_2S_{12} + R_1 \} / [P_1(1 + t_1)]^{\sigma_1} \{ \alpha_{11}[P_1(1 + t_1)]^{1-\sigma_1} + \alpha_{12}P_2^{1-\sigma_1} \} \\ X_{12} &= \alpha_{12} \{ P_1(1 + t_1)S_{11} + P_2S_{12} + R_1 \} / P_2^{\sigma_1} \{ \alpha_{11}[P_1(1 + t_1)]^{1-\sigma_1} + \alpha_{12}P_2^{1-\sigma_1} \} \end{aligned} \quad (28)$$

$$\begin{aligned}
X_{21} &= \alpha_{21} \{P_1 S_{21} + P_2(1+t_2)S_{22} + R_2\} / P_1^{\sigma_2} \{\alpha_{21} P_1^{1-\sigma_2} + \alpha_{22} [P_2(1+t_2)]^{1-\sigma_2}\} \\
X_{22} &= \alpha_{22} \{P_1 S_{21} + P_2(1+t_2)S_{22} + R_2\} / [P_2(1+t_2)]^{\sigma_2} \{\alpha_{21} P_1^{1-\sigma_2} + \alpha_{22} [P_2(1+t_2)]^{1-\sigma_2}\}
\end{aligned}$$

When we define $P = P_2/P_1$ and $\alpha_i = \alpha_{i2}/\alpha_{i1}$ for each $i = 1, 2$, we will find:

$$\begin{aligned}
X_{11} &= S_{11} + PS_{12} / 1 + \alpha_1 P^{1-\sigma_1} (1+t_1)^{\sigma_1} \\
X_{12} &= \alpha_1 (1+t_1)^{\sigma_1} / P^{\sigma_1} X_{11} \\
X_{21} &= S_{21} + PS_{22} / 1 + \alpha_2 P^{1-\sigma_2} (1+t_2)^{-\sigma_2} \\
X_{22} &= \alpha_2 / P^{\sigma_2} (1+t_2)^{\sigma_2} X_{21}
\end{aligned} \tag{29}$$

The Nash equilibrium in this model is defined as a tariff pair (t_1, t_2) for region $i = 1, 2$ such that t_i maximizes $U_i(X_i)$ according to t_{2-i} . In other words, decisions to determine tariffs are bilateral. Therefore, for each t_2 , the consumption of the second region is as Equation (29) for country 2 and t_1 solves the following optimization problem.

$$\begin{aligned}
& \max_{t_1} U_1(X_{11}, X_{12}) \\
& \text{s. t. } P_1(1+t_1)X_{11} + P_2X_{12} = I_1 \\
& (X_{11} - S_{11}) + (X_{21} - S_{21}) = 0 \\
& (X_{12} - S_{12}) + (X_{22} - S_{22}) = 0
\end{aligned} \tag{30}$$

where t_1 is a function of P and t_2 or $t_1 = f_1(P, t_2)$ is the response function of Region 1 to t_2 . Similarly, for any given t_1 , country consumption is as Equation (29) for country 1, and t_2 solves the following optimization problem:

$$\begin{aligned}
& \max_{t_2} U_2(X_{21}, X_{22}) \\
& \text{s. t. } P_1X_{21} + P_2(1+t_2)X_{22} = I_2 \\
& (X_{11} - S_{11}) + (X_{21} - S_{21}) = 0 \\
& (X_{12} - S_{12}) + (X_{22} - S_{22}) = 0
\end{aligned} \tag{31}$$

where t_2 is a function of P and t_1 or $t_2 = f_2(P, t_1)$ is the response function of Region 2 to t_1 . If (t_1, t_2) solves functions $t_1 = f_1(P, t_2)$ and $t_2 = f_2(P, t_1)$, (t_1, t_2) is a Nash equilibrium, then the Nash equilibrium is determined by solving the two reaction functions in the tariff space.

Using the CES desirability function produces Equations (32) and (33):

$$\begin{aligned}
 U_1(X_{11}, X_{12}) &= \left\{ \alpha_{11}^{1/\sigma_1} X_{11}^{\sigma_1-1/\sigma_1} + \alpha_{12}^{1/\sigma_1} X_{12}^{\sigma_1-1/\sigma_1} \right\}^{\sigma_1/\sigma_1-1} = \\
 &\left\{ \alpha_{11}^{1/\sigma_1} X_{11}^{\sigma_1-1/\sigma_1} + \alpha_{12}^{1/\sigma_1} \left[\frac{\alpha_1(1+t_1)^{\sigma_1}}{P^{\sigma_1}} X_{11} \right]^{\sigma_1-1/\sigma_1} \right\}^{\sigma_1/\sigma_1-1} = \alpha_{11}^{1/1-\sigma_1} \{1 + \\
 &\alpha_1 P^{1-\sigma_1} (1+t_1)^{\sigma_1-1}\}^{\sigma_1/\sigma_1-1} X_{11}
 \end{aligned} \tag{32}$$

$$\begin{aligned}
 U_2(X_{21}, X_{22}) &= \left\{ \alpha_{21}^{1/\sigma_2} X_{21}^{\sigma_2-1/\sigma_2} + \alpha_{22}^{1/\sigma_2} X_{22}^{\sigma_2-1/\sigma_2} \right\}^{\sigma_2/\sigma_2-1} \\
 &= \left\{ \alpha_{21}^{1/\sigma_2} X_{21}^{\sigma_2-1/\sigma_2} \right. \\
 &\quad \left. + \alpha_{22}^{1/\sigma_2} \left[\frac{\alpha_2}{P^{\sigma_2} (1+t_2)^{\sigma_2}} X_{21} \right]^{\sigma_2-1/\sigma_2} \right\}^{\sigma_2/\sigma_2-1} \\
 &= \alpha_{21}^{1/\sigma_2-1} \{1 + \alpha_2 P^{1-\sigma_2} (1+t_2)^{1-\sigma_2}\}^{\sigma_2/\sigma_2-1} X_{21}
 \end{aligned} \tag{33}$$

Finally, Equations (32) and (33) are modified as follows. For each given t_2 , t_1 solves the optimization problem of Equation (34):

$$\begin{aligned}
 \max_{t_1} &\{1 + \alpha_1 P^{1-\sigma_1} (1+t_1)^{\sigma_1-1}\}^{\sigma_1/\sigma_1-1} S_{11} + PS_{12} / 1 + \alpha_1 P^{1-\sigma_1} (1+t_1)^{\sigma_1} \\
 \text{s. t.} &\alpha_1 P^{1-\sigma_1} (1+t_1)^{\sigma_1} S_{11} - PS_{12} / 1 + \alpha_1 P^{1-\sigma_1} (1+t_1)^{\sigma_1} \\
 &+ \alpha_2 P^{1-\sigma_2} (1+t_2)^{-\sigma_2} S_{21} - PS_{22} / 1 + \alpha_2 P^{1-\sigma_2} (1+t_2)^{-\sigma_2} = 0
 \end{aligned} \tag{34}$$

The reaction function of country 1 is $t_1 = f_1(P, t_2)$. Similarly, for any given t_1 , t_2 solves the optimization problem of Equation (35):

$$\begin{aligned}
 \max_{t_2} &\{1 + \alpha_2 P^{1-\sigma_2} (1+t_2)^{1-\sigma_2}\}^{\sigma_2/\sigma_2-1} S_{21} + PS_{22} / 1 + \alpha_2 P^{1-\sigma_2} (1+t_2)^{-\sigma_2} \\
 \text{s. t.} &\alpha_1 P^{1-\sigma_1} (1+t_1)^{\sigma_1} S_{11} - PS_{12} / 1 + \alpha_1 P^{1-\sigma_1} (1+t_1)^{\sigma_1} \\
 &+ \alpha_2 P^{1-\sigma_2} (1+t_2)^{-\sigma_2} S_{21} - PS_{22} / 1 + \alpha_2 P^{1-\sigma_2} (1+t_2)^{-\sigma_2} = 0
 \end{aligned} \tag{35}$$

Therefore, the above two optimization problems are solved simultaneously to find the optimal tariff for each region in the game.

Literature Review

Ghosh (2002) analyzed the different consequences of potential regional trade arrangements for small, medium, and large countries using simulations by a Computable General Equilibrium (CGE) model of eight member regions of world trade. This author applied a competitive equilibrium structure in which regional trade arrangements are in the form of tariff reduction among members and tariff levels are kept fixed with other countries. Also, they used a non-cooperative Nash equilibrium structure in which regional trade transactions affect member countries and non-member countries. According to that research, regional trade arrangements have more benefits for large countries, but small countries suffer significant losses. Thus, according to other results, large countries can compete and become successful in trade, and the development of regional trade arrangements has been the main concern for small countries.

Dennis (2006) examined the impact of regional trade agreements on trade facilitation in the Middle East and North Africa region, based on data related to 13 regions and 16 commodities. According to the results, intra-regional integration and integration with the European Union have had a positive effect on welfare in this region. Lee and Kim (2012) studied the Free Trade Agreement of ASEAN member countries plus Korea, China, and Japan under different market structures. To this end, they also used a regional static general equilibrium model based on data related to 8 regions and 16 commodities in 2004. These researchers compared the economic effects of Free Trade Agreements between the countries and then the economic results. According to the results of the model simulations, the Free Trade Agreement will have more economic benefits for the East Asian economy. Shaikh et al. (2015) examined the impact of Pakistan-India relations regarding rice trade on the Pakistani economy using the Computable General Equilibrium (CGE) model. According to their results, there was a positive impact on rice exports to India. In addition, considering the Most-Favored-Nation (MFN) clause in Pakistan's exports to India, Pakistan's imports will decrease while its exports will increase, positively affecting the economy. Meanwhile, Shirazi et al. (2016), Rasoulinezhad and Popova (2017), and Rasoulinezhad (2018) examined, in separate articles, countries such as Iran and Russia and the effect that economic sanctions have on the trade of these countries. Abrego et al. (2019) examined the African Continental Free Trade Area (AfCFTA) to assess welfare for 45 countries in Africa using a multi-country, multi-region general equilibrium model. The simulations included the complete elimination of import tariffs and the significant reduction of non-tariff barriers. According to the results, there is a potentially

significant welfare gain due to trade liberalization in Africa. Since import tariffs in Africa are low, a large portion of these benefits is due to the reduction of non-tariff barriers. Yi (2020) used a Computable General Equilibrium Model (CGE) to examine the impact of reducing tariff and non-tariff barriers on the trilateral free trade agreement between South Korea, Japan, and the European Union. This study indicates that reducing import tariffs and non-tariff barriers due to trilateral free trade between South Korea, Japan, and the European Union may increase gross domestic product, exports, and imports for all three nations. Moreover, this free trade agreement benefits all countries participating in the arrangement, namely South Korea, Japan, and the European Union, and it can contribute to global welfare. Thus, the South Korea-Japan-European Union free trade agreement will benefit these three countries and constitute a win-win strategy for the global community.

Shiferaw Amogne and Hagiwara (2021) examined the effect of alternative regional trade arrangements on the Ethiopian economy using a general equilibrium model. The Common Market for Eastern and Southern Africa (COMESA) is a free trade agreement in Africa. This study evaluates the impact of three regional trade agreements—the Free Trade Agreement, the Customs Union Agreement, the European Partnership Agreement (EPA), and the Common Market for Eastern and Southern Africa (COMESA)—on the Ethiopian economy. The results show that free trade in the market under study has resulted in reduced welfare in Ethiopia. Larch et al. (2023) focused on integrating the Central European Free Trade Agreement (CEFTA) and the European Union into their research. The results regarding General Equilibrium (GE) highlight potentially significant gains for CEFTA countries upon joining the European Union. Beckman et al. (2023) employed a “Nash in Nash” framework within a computable general equilibrium model to determine the welfare-maximizing set of bilateral trade agreements for the participating countries of the Trans-Pacific Partnership. The results indicate that welfare is always greater in larger multilateral agreements. According to these studies, analyzing the consequences and welfare effects of regional trade agreements between countries has been one of the main goals. However, the present study aims to discuss the effects member countries of the agreement have on each other and on non-member countries. To this end, a new method was used to examine the interactions of countries in each other’s objective functions. Moreover, their reaction was investigated by the Nash tariff game, and the optimal tariff resulting from the war was found.

Methods and Materials

Production data were used to numerically implement the welfare model of trade between countries that have a great political impact on the Middle East region and want to solve the region's problems by holding various meetings, such as the Astana Conference. These data were based on the base year 2015, and the final household consumption index as a percentage of GDP was used for the consumption variable according to the World Bank website for Iran, Turkey, and Russia, focusing on Iraq. Trade statistics and reciprocal tariffs of countries in 2021 were also based on the International Trade website.

After simulating the agreement and its welfare effect as a trading region on member and other non-member countries, we employed a general trade equilibrium model consisting of the four countries. This model determines the competitive equilibrium in which the tariff rate is exogenous. In this respect, the member countries of the agreement trade with each other at zero tariffs (free trade). However, for trade with other non-member countries, the tariff rate is considered to be the one that had been used before the agreement. Since the conclusion of the agreement disturbs the initial trade balance of countries in international trade, countries will use strategies such as tariffs or creating tariff barriers in a trade war. Therefore, to examine the agreement in the real world, a non-cooperative equilibrium structure was used in which each region determined its optimal tariffs considering the reciprocal behavior of the other region. In other words, in this situation, the optimal tariff rate of each region is a function of the tariff rate of the other region. Hence, the tariff rate is determined endogenously. In the following, we discuss the consequences of the trade arrangements using both equilibrium structures for member and non-member countries.

To measure the welfare level according to each type of simulation of regional agreement between countries, a CES function was estimated and the Nash tariff game was employed to examine the tariff determined by the game in the original model. Afterward, the welfare effects of the trade war are examined. Thus, the model proposed in this study is implemented numerically using calibration in a regional equilibrium for the four countries in 2021. The parameters of elasticity of substitution are required before performing the calibration steps using the CES functions. The elasticity of import demand by region is based on the study conducted by Kee et al. (2008) to guide other major trade elasticities in this model. The calibration used in this research is based on the method described in the studies of Mansur and Whalley (1984) and Shoven and Whalley (1992).

The Iraqi market is one of the most important regional markets in the region. According to the International Trade Center, this market is highly dependent on imports of consumer goods and capital inputs and is considered one of the best markets for Iran. According to information from the International Trade Center, China, Iran, and Turkey are the largest exporters of goods and services to Iraq, and there is intense competition between these countries for better access to the Iraqi market.

On the other hand, Russia, as Turkey's maritime neighbor, has a larger volume of trade with Turkey than other countries in the region. According to the International Trade Website, Russia has recently increased its relations with Iran and Iraq. As evident from Table (1), which presents bilateral trade statistics for the four countries in the model, the export shares of Iran, Turkey, and Russia to Iraq indicate that Iran and Turkey allocate a substantial portion of their exports to Iraq and aim to gain a larger share of this market.

Table 1. Reciprocal Trade of Countries in 2021 (Million Dollars)

	Iraq	Iran	Turkey	Russia
Iraq	-	1196	1664	49
Iran	8914	-	6080	578
Turkey	11131	2770	-	5775
Russia	282	3068	26426	-

Source: International Trade Site (www.intracen.org).

The reciprocal tariff data of the countries are also available in Table (2). As Table (2) demonstrates, Iran applies higher tariffs on imported goods than Turkey and Russia. This phenomenon signifies a strong inclination by Iranian policymakers to employ tariff instruments to support domestic production. The tariff system reflects each country's competitiveness in the global market. As the latest trade statistics available for Iran, Russia, and Iraq are up to 2021, this article focuses on this specific timeframe.

Table 2. Mutual Tariffs of Countries

	Iran	Turkey	Russia
Iran	-	23.18	23.18
Turkey	11.06	-	14.10
Russia	6.12	6.37	-

Source: International Trade Site (www.intracen.org).

Due to globalization, developed or developing countries seek to develop their relations with other countries. These countries aim to increase trade volume and accelerate economic development. International trade and the provision of capital for developing countries positively impact increased investment and, consequently, increased welfare. Table 3 shows the countries' production, consumption, and import demand elasticity statistics in 2021.

The import elasticity rate for all goods (Table 3) is about 1. Nonetheless, researchers often argue that the elasticity rates are low and are currently the source of strong inter-regional effects of trade policy changes in the model. Therefore, this paper uses sensitivity analysis to investigate the consequences of using the elasticity substitution rates used in the model.

Table 3. Production, Consumption, and Import Demand Elasticity in 2021

	Production (billion dollars)	Consumption	Import demand elasticity
Iran	469.94	43.14	1.32
Turkey	1131.04	55.29	1.32
Russia	1502.65	49.22	1.57

Source: [World Bank](#).

The key behavioral parameters in the model are the substitution elasticities in preferences, which are represented at two levels. The elasticities include the ease of substitution between imports (based on the region of origin) and between imports as a composite commodity and domestic production. Elasticities are important parameters in the model. The elasticity determines the impact of trade on the competitive equilibrium and the level of optimal tariffs in the non-cooperative Nash equilibrium. Due to the lack of access to the required information and the difficulty of the calculations, the substitution elasticities are based on previous studies. The substitution elasticity rates used in the model are based on the studies of McDougall (1997) and Ghosh (2002). Low-level substitution elasticity, for example, is assumed to be 1.5 times the import demand elasticity.

All calculations in this paper were performed using Generalized Algebraic Modeling System (GAMS) software. Also, equilibrium tariff rates in the Nash retaliatory method were measured by integrating the weighted coefficients and LP-Metric methods using GAMS software.

Results of General Equilibrium Modeling According to Game Theory and Competitive Equilibrium

Various possible and hypothetical reciprocal tests have been performed under model solutions (competitive equilibrium and non-cooperative Nash equilibrium) to understand the consequences of different regional trade arrangements. In addition, the welfare changes of countries were examined in different situations (see Equation 12). For this purpose, related models and parameters have been provided based on calibration, and the data related to 2021 were used.

The simulation results of a trade agreement among different regions in the model with Iraq, under the competitive equilibrium and Nash equilibrium, are available in Table 4. The table shows the results of the report under the competitive model and the results according to the Nash calculations. In both models, it is assumed that there is free trade between the member countries of the agreement, and the difference is in the treatment of non-member countries. The welfare level of countries is reported in billions of US dollars.

According to Table 4, the welfare level obtained under a simple competitive equilibrium and based on Equation (12) in the Theoretical Basis section is higher than under a non-cooperative Nash equilibrium because of the elimination of bilateral tariffs between partners and non-participation in the tariff war. A simple FTA agreement between Iraq, Iran, and Turkey would greatly improve the welfare level achieved by the agreement in terms of competitive equilibrium (gaining 0.44 billion). However, in the game of retaliatory tariffs, when the regions are involved in a tariff war, the welfare level of the members of the agreement (0.02 billion) will be lower. This difference is because only bilateral tariffs are eliminated under the competitive equilibrium, and the tariff rate against the other region remains unchanged. Meanwhile, under the non-cooperative Nash equilibrium, the bilateral tariffs between Iraq, Iran, and Turkey are eliminated as in a competitive equilibrium. However, both Iraq-Iran-Turkey and Russia raised their preferred tariffs in a tariff war. Thus, when the reaction functions of the two regions intersect, the intersection point is considered the optimal tariff for both regions. Therefore, the initial competitive equilibrium and tariff liberalization in the model under the FTA improve the economic welfare level of countries compared to the retaliation situation.

Table 4. Simulation Results in Different Situations

	Iraq-Iran-Turkey	Iraq-Iran-Russia	Iraq-Turkey-Russia	Iraq-Iran-Turkey-Russia
Competitive equilibrium (US billion dollars)				
Iran	0.4472	0.0396	0.0329	0.1107
Turkey	0.4472	0.0534	0.0348	0.1107
Russia	6.6317	0.0396	0.0348	0.1107
Total Welfare	7.0789	0.0931	0.0678	0.1107
Non-Cooperative equilibrium (US billion dollars)				
Iran	0.0240	0.0345	0.0285	---
Turkey	0.0240	0.0443	0.0299	---
Russia	0.8041	0.0345	0.0299	---
Total Welfare	0.8282	0.0809	0.0584	---

Source: Research finding.

The benefits of retaliation obtained using Equations (34) and (35) in the “Theoretical Foundations” section are due to the increased price of imported products relative to the domestic product at the level of countervailing tariffs in countries, which would result in limited trade. Given that, in 2021, Iran and Turkey had the highest trade with Iraq compared to Russia, scenarios in which these two countries are excluded from an agreement would not lead to a substantial difference in welfare resulting from that agreement compared to outside it. However, because Russia possesses lower tariffs and a smaller trade share with Iraq under competitive equilibrium than Iran and Turkey, Russia’s welfare level would experience a noticeable change if it were outside the agreement, possibly even being significantly better off.

Therefore, it can be concluded that the best possible situation for reaching an agreement between the countries studied in this article, either through a competitive equilibrium or through the equilibrium resulting from the Nash tariff war, is an agreement between Iran, Iraq, and Turkey. The explanation is that, in this case, the welfare level of countries is at its highest. The worst case is an agreement between all the countries studied in this article (Iran-Iraq-Turkey-Russia).

According to Table 4, under non-cooperative Nash equilibrium, the welfare level in agreement simulations is much lower than that in competitive equilibrium. This issue can be explained by comparing the rates of reciprocal tariffs of countries

in Table 3 and the tariffs calculated by the tariff war, which are available in Figures 1 to 3.

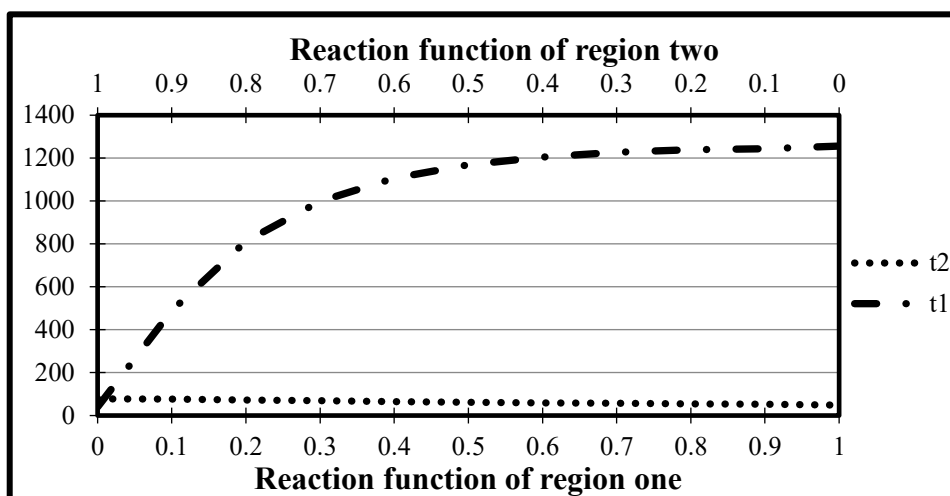


Figure 1. The reaction functions of Region 1 (Iran-Iraq-Turkey) and Region 2 (Russia) and the Nash equilibrium

Source: Research finding.

The reaction functions of the regions to the Nash tariff war can be represented in Figures 1 to 3. In these figures, the reaction function of Region1 (t_1) shows the reaction of the agreement's member countries. Also, the reaction function of Region2 (t_2) shows the reaction of the non-member countries of the agreement. The reaction functions are according to Equations (34) and (35) in the Theoretical Basis section. Accordingly, the horizontal axes show the coordinates of the weights given to the regions to achieve the optimal tariff.

As shown in Figure 1, since Iran and Turkey have the most trade with Iraq, the reaction function of the member countries of the agreement is greater than the reaction function of Russia and is increasing. The resulting equilibrium in this situation is 77.7%. According to Figures 2 and 3, the reaction functions of the two regions have a slight slope toward each other because the trade rate of Region 1 and Region 2 in both figures is almost the same.

The Nash equilibrium values obtained for the tariff war scenarios (second and third scenarios) are 105.01% and 98.41%, respectively. As the derived Nash equilibrium values illustrate, the tariff values in the second and third scenarios are higher than in the first. This outcome can be attributed to Iran and Turkey's larger trading volume relative to Russia with Iraq, indicating a higher bargaining power for Iran and Turkey.

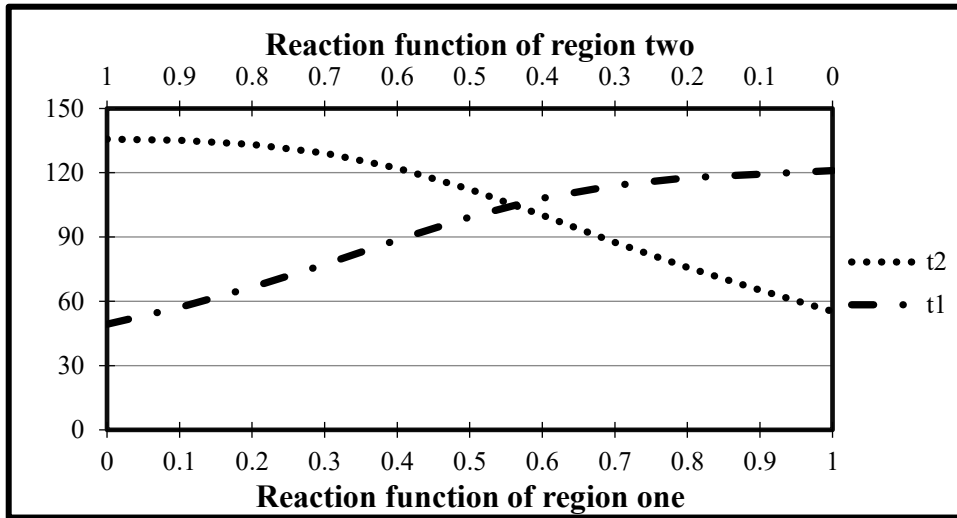


Figure 2. The reaction functions of Region 1 (Iran-Iraq-Russia) and Region 2 (Turkey) and the Nash equilibrium
Source: Research finding.

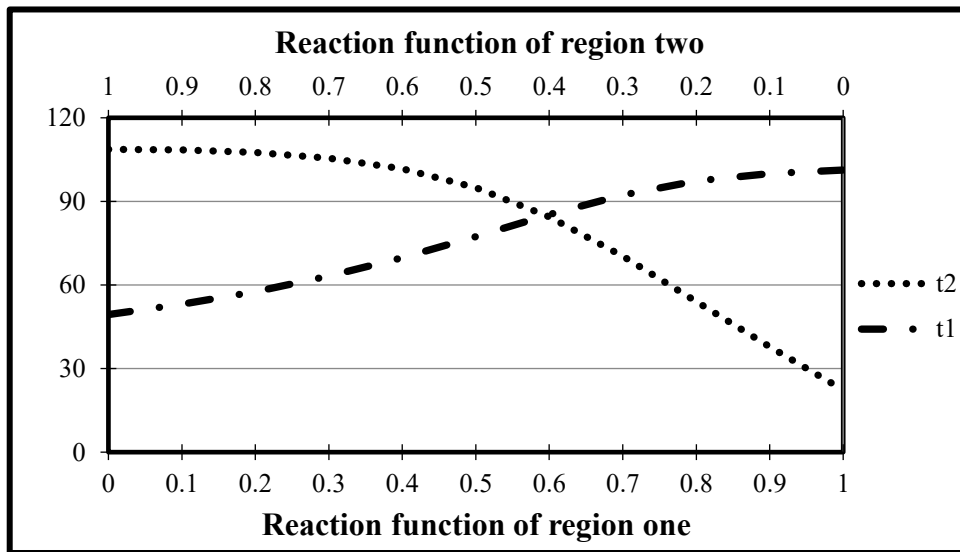


Figure 3. The reaction functions of Region 1 (Turkey-Iraq-Russia) and Region 2 (Iran) and the Nash equilibrium
Source: Research finding.

Robustness

The rate of substitution elasticity depends on the ratio of the impact of import demand to domestic demand for a good. In this section, the rate of substitution elasticity in the first test increased by 25% and in the second test decreased by 25%,

according to the results in Table 4. The results of both sensitivity tests are available in Table 5.

Table 5. Results of Sensitivity Analysis

	Iraq-Iran-Turkey	Iraq-Iran-Russia	Iraq-Turkey-Russia	Iraq-Iran-Turkey-Russia
%25 Increase in Substitution Elasticity				
Competitive Equilibrium	16.370	0.0938	0.0683	0.1105
Nash Equilibrium	1.0913	0.0815	0.0588	---
%25 Decrease in Substitution Elasticity				
Competitive Equilibrium	5.7358	0.0931	0.0678	0.1110
Nash Equilibrium	0.6256	0.0809	0.0584	---

Source: Research finding.

Table 5 indicates the impact of substitution elasticity on the welfare level. The greater the substitution elasticity, the less negative the effect of the policy on household welfare and the greater the transmission of price changes. In other words, a 1% change in the ratio of domestic price to import price will result in more changes (more than 1%) in the rate of imports to domestic production. In other words, in the case of the reduction of tariffs and protections, and in case of a reduction in the import price compared to the domestic price, the rate of imports will increase much more than domestic production. Hence, the welfare level of society will be higher.

A goodness-of-fit test was used to address criticism of the use of calibration in analyses of general equilibrium models. The test examines the degree of stability of the estimated parameter and the simulation results. According to Nabuhiro et al. (2010), the test is used for two purposes: 1) to test the stability of the simulation results concerning hypothetical values for some key parameters, and 2) to provide a kind of confidence interval for the simulation results.

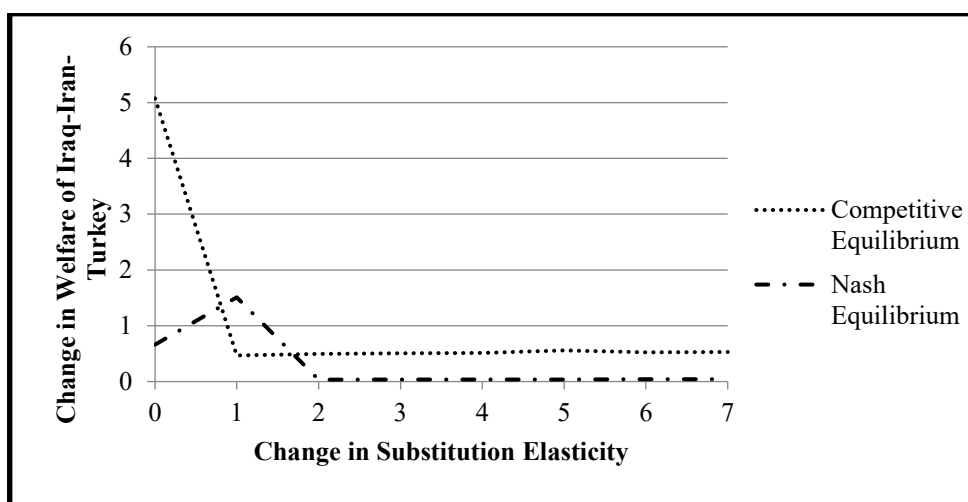


Figure 4. Changes in Iraq-Iran-Turkey welfare level concerning changes in substitution elasticity under the two approaches of competitive equilibrium and Nash equilibrium

Source: Research finding.

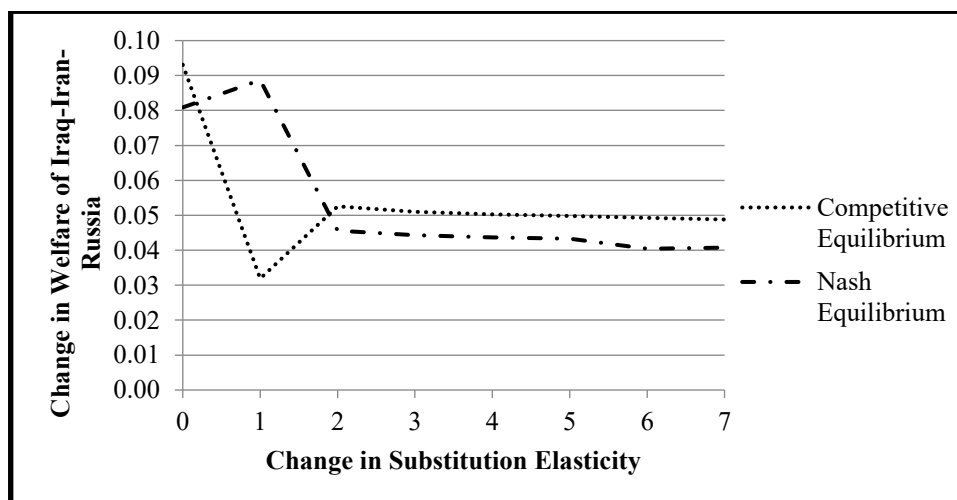


Figure 5. Changes in Iraq-Iran-Russia welfare level concerning changes in substitution elasticity under the two approaches of competitive equilibrium and Nash equilibrium

Source: Research finding.

As discussed, according to Figures 4 to 6, the substitution elasticity used in the model greatly impacts the results. A change in this parameter has caused a change in the welfare level achieved under the situations considered in this study.

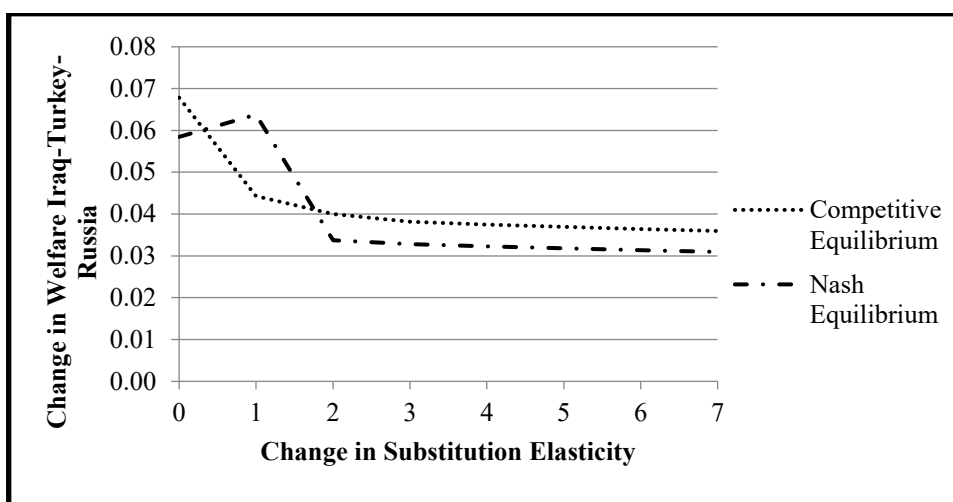


Figure 6. Changes in the welfare level of Iraq-Turkey-Russia concerning changes in substitution elasticity under the two approaches of competitive equilibrium and Nash equilibrium

Source: Research finding.

According to Figures 4 to 6, when there is a change in substitution elasticity, the welfare level under different situations is changed over a special period. In other words, in the general equilibrium model under the two approaches of competitive equilibrium and Nash equilibrium, the rate of welfare level change in period 0.3 to 2 is different according to the change in substitution elasticity. Furthermore, following substitution elasticity 2, the variables do not change significantly and become stable.

Conclusion

Success in any trade agreement requires partner countries to have a complementary trade structure in order to benefit mutually. Economies with similar trade structures often try to increase their trade share (Chandran, 2010). Therefore, the present paper discusses an optimal strategy in trade relations among Iran, Turkey, Russia, and Iraq, and the trade profitability arising from their integration. The reason for this effort is that the possibility of creating trade ties between neighboring countries is greater than the possibility of trade diversion. Iraq is a consumer market, and countries are willing to trade with Iraq. In addition, Turkey, Iran, and Russia are economic hubs in the region and have a great impact on Iraq's political relations. Hence, the present study examined the feasibility of establishing a regional trade agreement between these countries. The model used in this paper to assess the

different effects of regional trade arrangements is the Computable General Equilibrium model. This model is a new version of the Nash retaliatory tariff and trade structure developed by Gorman (1957) and Johnson (1954). It is important to note that although the welfare effects of establishing trade agreements among countries extend beyond the findings of this paper, the emphasis should be on the fact that the present study considered welfare effects within the framework of the economic models mentioned. The findings of this study, based on data from 2021, include:

1. Table 4 effectively demonstrates the significant impact of tariff wars among countries on a sharp decline in overall welfare. As previously mentioned, the welfare value obtained under simple competitive equilibrium, due to the elimination of bilateral tariffs between participants and the non-participation of either party in the tariff war, is greater than that of the non-cooperative Nash equilibrium.
2. Considering that among the countries discussed in this article, Iran and Turkey had the highest level of trade with Iraq in 2021, in the event of a regional agreement from which each of these two countries is excluded, the welfare level for Iran, Turkey, and Russia would be lower than in other simulation scenarios.
3. According to the competitive equilibrium and non-cooperative Nash equilibrium models, establishing a trade agreement between Iran, Iraq, and Turkey would result in the highest welfare level for the countries. Besides, establishing a trade agreement with the participation of all countries would result in the lowest welfare level for the countries.
4. As Beckman et al. (2023) noted in their article, welfare calculations for trade agreements are heavily influenced by Armington substitution elasticities, which affect the amount of welfare lost due to trade restrictions. Based on this, a sensitivity analysis was conducted to validate the results in Table 4. This involved varying the Armington elasticity by around $\pm 25\%$. Overall, the sensitivity analysis confirmed the validity of Table 4.
5. The results strongly depend on the substitution elasticity of domestic and imported goods (Armington elasticity). Thus, if there is little change in the elasticity, as shown in the sensitivity analysis section, the welfare level will change significantly.

In most countries, few trade barriers exist due to WTO tariff liberalization in the 1980s and 1990s. Even if the estimated effects of trade integration on a non-member country in the model simulations are insignificant, there are many concerns

about the development of regionalism for developing countries (Ghosh, 2002). Therefore, given the concerns and bargaining in negotiations for market access, governments should analyze the consequences of the measure in various economic sectors to determine the strategy and negotiating positions and manage the accession process.

Bilateral and multilateral regional trade agreements have many advantages for countries. For instance, their benefits for Iran include bypassing sanctions, eliminating intermediary currencies, facilitating access to foreign markets, and increasing economic influence in those markets. This study suggests that the government should pursue a regional agreement with Turkey and Iraq to develop the country's industry, because the welfare effects of a regional agreement are directly affected by production effects.

Statements and Declarations

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