

## **Evaluating Economic Effects of Exchange Rate Depreciation on the Rice Market in Iran**

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### **ABSTRACT**

**In recent years, Iran has experienced high level depreciation of the Nominal Exchange Rate (NER). The ultimate effects of such depreciation on Iranian families' welfare and income distribution have been a challenging issue among policymakers and researchers. Accordingly, this study evaluates the economic effects of NER depreciation on the rice market, using spatial price equilibrium model. The model was calibrated for the base year 2010 and was executed using GAMS programming language and was solved by the PATH solver. The results suggested that decreasing the NER would be detrimental. Social welfare is adversely affected by depreciation of the NER. This shock would also decrease real and per capita income and increase slightly the incidence, the gap, and severity of poverty. Also, the regional effects were found to vary, depending on being a net exporter or a net importer region. Overall, this study contributes to previous studies by considering income effects and import exemptions in the model.**

**Keywords:** Nominal exchange rate, Spatial price equilibrium model, Welfare.

### **INTRODUCTION**

Devaluation of exchange rate is accompanied with promotion of export and increasing domestic production, because exporters receive more in domestic currency than they would have received at a higher benchmark rate, and importers pay more in domestic currency than they would have paid at the same higher benchmark rate. Thus, devaluation acts as an implicit subsidy on exports and an implicit tax on imports (Koo and Kennedy, 2005). These kinds of policy are prevalent in Iranian agricultural markets since, in coping with global food price increase, Iranian government puts supporting infant industries and self-efficiency policies in their agenda in the agricultural sector (Mosavi and Esmaeili, 2012). Meanwhile, production of crops such

as rice, wheat, and corn, which were considered as staples agricultural commodities, was supported more than the other crops. Protections were performed by commercial controls, input supports, providing credit and production infrastructures in agriculture such as developing pressurized irrigation systems and increase in mechanization level (Parmeh, 2010). These protections are very significant in the rice market because Iran is one of the biggest rice importers in the world, importing over 1.3 million metric tons per annum (FAOSTAT, 2010). However, studies have indicated, the most significant and common policy to support rice production has been import restrictions, which were put into practice using various tools such as imposing import quotas, tariffs, and non-tariff barriers, and devaluation of

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national currency (Bakhshoodeh and Thomson, 2006; Parmeh, 2010; Mosavi and Esmaili, 2012). In relation to exchange policies, it should be mentioned that, in early 2000s, Iran had a multiple exchange rate system which turned into a controlled single-rate system. Subsequently, this policy brought a relatively proper stability during 2002 to 2010. The NER was set to be around 0.0001 US \$ per Rials (Iranian local currency), but the NER experienced a sudden 40 percent decrease from the late 2010 to 2012 by the increase in international sanctions, financial crisis, and intense fluctuations in regional and international stock markets. However, exchange rate policies have not been changed after 2010. The aforementioned reasons were responsible for the drastic depreciation of NER. Therefore, the NER decreased from 0.0001 to 0.00006 US \$ per Rials. (Central Bank of Iran)

Several studies investigated different aspects of the exchange rate policy in agricultural market especially rice (Robinson *et al.*, 1998; Buguk *et al.*, 2003; Kemal and Kadir, 2005; Jamora *et al.*, 2010; Eichengreen and Tong, 2011; Erdal *et al.*, 2012) throughout the world. These studies found that overvaluation of exchange rate and its volatilities had a deleterious effect on economic growth in terms of reduced investment and international trade leading to low or negative growth rates in per capita income, exports, and agricultural output. However, these studies ignored the status of consumers, while overvaluation of exchange rate can have positive effects on consumer welfare and poverty through increasing import volume and reducing domestic price

of the imported rice.

Unfortunately, little studies have been conducted on Iranian exchange rate policies in the agricultural markets. In one such study, Moteiee (1995) found that although rice import was adversely affected by devaluation, rice farmers' decision about area and input use were not affected. He argued that devaluation was also ineffective in increasing rice production. Also, Bakhshoodeh and Thomson (2006) evaluated welfare effects of removing multiple exchange rates in the Iranian rice market. They showed that removing trading controls through conforming exchange rate systems increased import and decreased domestic rice production. From welfare analysis point of view, although producers' welfare decreases through this policy, public welfare grows through increase in consumers' welfare. The aforementioned studies have only investigated the rice market at national scale, while changing climates and also rice production and consumption patterns have resulted in more complexity in impact analysis of various policies in Iranian rice market (Mosavi and Esmaili, 2011). Considering rice market specifications such as prices, production and consumption, the share of domestic production in the consumption basket and also using clusters analysis, Mosavi and Esmaili (2011) have divided Iran's rice market into six regions in which there is spatial arbitrage. Table 1 presents details about the regions. Region 1 includes three northern provinces of Iran (Guilan, Mazandaran, and Golestan), where prevalence of proper characteristics for cultivating rice accounted for more than 85

**Table 1.** Spatial regional rice markets in Iran.

Regions	Geographical location	Position in the rice market
Region 1	Three most northern provinces	Net exporter
Region 2	Seven provinces in the northwest	Net importer
Region 3	Five central provinces	Net importer
Region 4	Eight provinces in the west and southwest	Autarkic
Region 5	Four provinces in south and southeast	Net importer
Region 6	Three provinces in the east and northeast	Net importer

Source: Mosavi and Esmaili (2011).

percent of the total domestic rice production. Mosavi and Esmaili (2012) proved that Region 1 was the sole net exporter region by applying two criteria: consumption benefit ratio and production benefit ratio. Also, they showed that rice was exported from this region into the other 5 domestic regions. Cultivating local varieties is prevalent in Region 4 so that this region stands for the second ranked rice production site by producing 12 percent of the total domestic rice. Although rice is an important food in the consumption basket in all regions, other regions have little potential for growing rice and import it from Region 1 as well as international market.

Subsequent to determine tariffs equivalent of nontariff barriers, they have explained that policies among these region could be quite different. Also, after developing a spatial equilibrium model for Iran's rice market, Mosavi and Esmaili (2011) have conducted a welfare analysis of tariff policies in various regions of Iran. It was observed that production support through setting import tariffs could lead to social losses in the whole country and only the surplus regions benefit from this policy.

The main point that was ignored in the previous studies is the incomes effects of the supportive policies. According to the previous studies, it is expected that exogenous shocks such as NER depreciation affects rice production and, in turn, the income generated in agricultural sector. Moreover, another point that was absent in the previous studies is the rice import exemption. Rice is among the crops which are imported by the frontiersmen's cooperatives or border exchanges card holders. Since such imports have been exempted from custom duties and commercial benefits, setting tariff policies have been ignored. However, in recent years, such policies for frontiersman's cooperation have changed and according to the government approval, for any import tariff greater than 4 percent, importing edible rice up to 50 kilograms for each individual per year i.e. about 30 percent of total

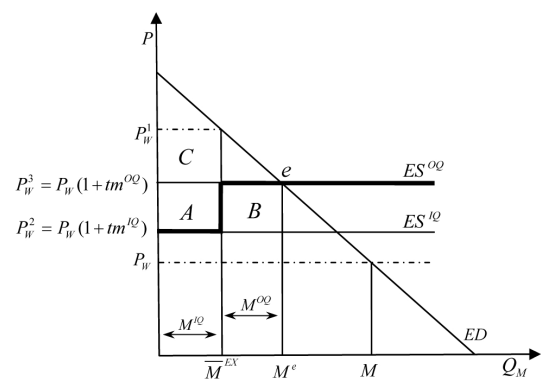
imports, are subjected to 55 percent exemption. Critics believe that tariff exemptions are effective factor in decreasing supporting effects of tariff policies, therefore, they advocate decreasing or eliminating tariff exemptions in order to better support rice productions (Mosavi, 2011).

The objective of the following research was to form an analytic framework for quantitative query of depreciation of the NER in Iran's rice market, using multi-market spatial price equilibrium model. This study contributes to the literature in twofold. First, two types of import schemes i.e. with and without tariff exemption, are considered. Second, income is incorporated endogenously in the model, which is not reported for any kind of Iranian agricultural markets until now.

## MATERIALS AND METHODS

### Theoretical Framework

The past studies have shown that the rice trade of Iran is too small to influence the world price and the country faces a perfectly elastic export supply schedule from the rest of the world, as shown in Figure 1 (Mosavi, 2011; Mosavi and Esmaili, 2011; 2012). Iran imports  $M$  tons of rice at the world price of  $P_w$  per ton under free trade. If the country imposes an import quota with



**Figure 1.** Tariff exemption in the Iranian rice market.



exemption about  $\bar{M}^{EX}$  which is one third of  $M$  for frontiersman's cooperatives, the domestic price increases from  $P_w$  per ton to  $P_w^1$ , while the world price remains at  $P_w$ . Therefore, frontiersman's cooperatives receive a quota profit represented by area  $A + C$ .

In other words, Iran adopts a two-tier tariff system such that in quota tariff i.e. tariff for imports less than  $\bar{M}^{EX}$  is equal to  $tm^{IQ}$  and over quota tariff i.e. tariff for imports larger than  $\bar{M}^{EX}$ , is equal to  $tm^{OQ}$ . The supply schedule of imports with the tariff-rate quota is shown by the bold line in Figure 1; the supply schedule is  $ES^{IQ}$  for imports less than  $\bar{M}^{EX}$  and  $ES^{OQ}$  for imports larger than  $\bar{M}^{EX}$ . The market equilibrium is obtained at point  $e$ , where  $ES^{OQ}$  intersects the country's import demand schedule  $ED$ . The country imports  $M^e$  units at the price of  $P_w^3$  per ton. Since the first  $M^{IQ}$  ton enter by  $tm^{IQ} = 0.55tm^{OQ}$ , the importer's quota profit is area  $A$ . Also, government gets a tariff revenue equal to area  $B$ .

### The Model

Numerous data sources were used to update and extend the Iranian Rice Spatial Price Equilibrium Model (IRSPEM) that was previously developed by Mosavi and Esmaili (2011) to analyze rice import tariff policy in Iran. Our new model simulates four staple food markets in different regions of Iran; however, like Mosavi and Esmaili (2011), the main focus of this study is on the results of the model for high yield long grain local rice.

Since the pioneering work of Samuelson (1952) in modeling the spatial flow of commodities, and later popularized by Takayama and Judge (1964, 1971), the spatial equilibrium model has been extensively used by economists to model the inter-country/regional flow of commodities. In the case of this study, let  $\mathbf{R} = \{1, 2, 3, \dots, R\}$

and  $\mathbf{C} = \{1, 2, 3, \dots, C\}$  refer to sets of regions and commodities, respectively, therefore,  $\forall (c, c') \in \mathbf{C}$  and  $\forall (r, r') \in \mathbf{R}$ .

Let  $S_{cr}$  be supply function,  $a_{cr}^S$  and  $a_{cr}^D$  be supply and demand intercepts, respectively,  $S_{cr}^0$  be initial supply quantity,  $\gamma_{cc'r}$  be supply price elasticities which are estimated using times-series data,  $\beta_{cc'r}$  and  $\delta_{cr}$  be price and income coefficients in the Almost Ideal Demand System (AIDS) model, respectively, that are calculated using Marshallian demand function coefficients and the inverse functions of Green and Alston (1990),  $D_{cr}$  be demand function,  $BS_{cr}$  be budget share,  $POP_r$  be population,  $P_{cr}^d$  be consumers price,  $P_{cr}^s$  be producers price,  $P_r$  be Stone (1953) price index,  $TCW_{cr}$  be transport cost from each region to the boundary,  $PW_c$  be world prices,  $EXR$  be exchange rate,  $tm_c$  be import tariff,  $TC_{cr}$  be transport cost of commodities among regions,  $MAR_c$  be marketing margin of commodities among regions,  $ITT_{cr'}$  be transaction cost on domestic trade,  $MKT_{cr'}$  be marketing cost among regions,  $TQ_{cr'}$  be the quantity of interregional shipments from  $r$  to  $r'$ ,  $CONV_{cr}$  be conversion rate of commodities from sellers to buyers,  $ITM_{cr}$  be implicit import tax,  $ITX_{cr}$  be implicit export tax,  $X_{cr}$  be total export quantity,  $M_{cr}^{IQ}$  and  $M_{cr}^{OQ}$  be in quota and over quota import, respectively (with and without tariff exemption),  $\bar{P}^F$  be floor price,  $\bar{P}^C$  is ceiling price,  $ES_{cr}$  be excess supply,  $ED_{cr}$  be excess demand,  $BEG_{cr}$  be the beginning stock,  $END_{cr}$  be the ending stock,  $CPRO_{cr}$  be production costs as a proportion of production income,  $\bar{Y}_r^{NAG}$  be income received from non-agricultural works (considered fix), and  $Y_r$  be total per capita income.

In Equation (1), the quantity of each commodity supplied is specified as a semi-log function and also in Equations (2) to (4)

Find  $P_{cr}^d, P_{cr}^s, S_{cr}, BS_{cr}, P_r, D_{cr}, Y_r, TQ_{cr'r}, M_{cr}^{IQ}, M_{cr}^{OQ}, X_{cr}, PQ_{cr}, ES_{cr}, ED_{cr}$

$$S_{cr} = \alpha_{cr}^s + S_{cr}^0 \sum_{c'}^C [\gamma_{cc'r} \text{Ln}(P_{c'r}^s)] \quad (1)$$

$$BS_{cr} = \alpha_{cr}^D + \sum_{c'}^C [\beta_{cc'r} \text{Ln}(P_{c'r}^d)] + \left[ \delta_{cr} \text{Ln}\left(\frac{Y_r \text{POP}_r}{P_r}\right) \right] \quad (2)$$

$$P_r = \text{EXP} \left[ \sum_c BS_{cr} \text{Ln}(P_{c'r}^d) \right] \quad (3)$$

$$D_{cr} = BS_{cr} \left( \frac{Y_r \text{POP}_r}{P_{cr}^d} \right) \quad (4)$$

$$\sum_{r'=1}^R TQ_{cr'r} + M_{cr} + ED_{cr} \geq \sum_{c'=1}^C D_{cr} \quad \perp P_{cr}^d \geq 0 \quad (5)$$

$$\sum_{c'=1}^C [S_{cr} \text{CONV}_{cr}] \geq \sum_{r'=1}^R TQ_{crr'} + X_{cr} + ES_{cr} \quad \perp P_{cr}^s \geq 0 \quad (6)$$

$$Y_r = \left[ Y_r^{\text{NAG}} + \sum_{c=1}^C P_{cr}^s [S_{cr}] (1 - \text{CPR}_{cr}) \right] / \text{POP}_r \quad (7)$$

$$\left[ P_{cr}^s / \text{CONV}_{cr} \right] + TC_{cr} + \text{MKT}_{crr'} + \text{ITT}_{crr'} \geq P_{cr}^d \quad \perp TQ_{crr'}, TQ_{cr'r} \geq 0 \quad (8)$$

$$\left[ (PW_c + \text{MAR}_c)(1 + \text{tm}_c^{IQ}) \right] \text{EXR} + \text{ITM}_{cr}^0 + \text{TCW}_{cr} + PQ_c \geq P_{cr}^d \quad \perp M_{cr}^{IQ} \geq 0 \quad (9)$$

$$\left[ (PW_c + \text{MAR}_c)(1 + \text{tm}_c^{OQ}) \right] \text{EXR} + \text{ITM}_{cr}^0 + \text{TCW}_{cr} \geq P_{cr}^d \quad \perp M_{cr}^{OQ} \geq 0 \quad (10)$$

$$\left[ P_{cr}^s / \text{CONV}_{cr} \right] + \text{ITX}_{cr}^0 + \text{TCW}_{cr} \geq PW_c (1 - \text{tx}_c) \text{EXR} \quad \perp X_{cr} \geq 0 \quad (11)$$

$$\overline{M}_c^{\text{EX}} \geq \sum_{r=1}^R M_{cr}^{IQ} \quad \perp PQ_c \geq 0 \quad (12)$$

$$P_{cr}^s \geq \overline{P}^F \quad \perp ES_{cr} \geq 0 \quad (13)$$

$$\overline{P}^C \geq P_{cr}^d \quad \perp ED_{cr} \geq 0 \quad (14)$$

demand functions are specified based on the Linear Approximation of the Almost Ideal Demand System (LA-AIDS) (Deaton and Muelbauer, 1980). Also, Equation (3) is Stone's (1953) price index used to simulate Consumer Price Index (CPI). The two inequalities (5) and (6) maintain the commodity balance in each region, connecting total demand and inflow and total supply and outflows respectively. Per capita income in each region is specified by Equation (7). This is equal to the sum of per capita non-agricultural income and per capita farm

income. Inequality (8) refers to spatial arbitrage in the model and inequalities (9) to (11) refer to export and import parity prices. Inequalities (12) refer to import quantities which entered the country by 55% tariff exemption and inequalities (13) and (14) allow incorporation of price control in the model. Also, complementary slackness conditions provide for quota rent, prices, international and interregional trade quantities and excess supply and demand to become zero if the corresponding inequalities do not hold with strict equality.



As can be seen, the model formulated as a Mixed Complementarity Problem (MCP) approach (Rutherford, 1995). The MCP formulation was used in this study because it allows us to treat income as an endogenous variable in the model. In addition, the MCP formulation also solves non-integrable problems caused by *ad valorem* tariffs (Rutherford, 1995) that are extensively used in the Iranian rice market. Finally, IRSPEM was executed using GAMS programming language and was solved by the PATH solver (Ferris and Munson, 1998). IRSPEM was calibrated for the base year 2010 because it was the most recent year for which comprehensive and reliable data were available.

Also, let  $\Delta PS_r$  and  $\Delta CS_r$  be change in producer and consumer surplus,  $PBR_r$  and  $CBR_r$  be production and consumption benefit ratio,  $\varepsilon_{cc'r}^D$  be Marshallian elasticity of demand function. The change in social welfare,  $\Delta \omega_r$ , quota rent  $\Delta PQ$  (area A in Figure 1) and government surplus or tariff revenue  $\Delta GS$  (area B in Figure 1) were calculated as follows (Minot and Goletti, 2000):

$$\Delta PS_r = \left[ \frac{\Delta P^s}{P^s} PBR_r + \frac{1}{2} \left( \frac{\Delta P^s}{P^s} \right)^2 PBR_r \gamma_{cc'r} \right] Y_r \quad (15)$$

$$\Delta CS_r = - \left[ \frac{\Delta P^d}{P^d} CBR_r + \frac{1}{2} \left( \frac{\Delta P^d}{P^d} \right) CBR_r \varepsilon_{cc'r}^D \right] Y_r \quad (16)$$

$$\sum_r \Delta \omega_r = \sum_r [\Delta PS_r + \Delta CS_r] + \Delta GS + \Delta PQ \quad (17)$$

Also, it is possible to calculate the impacts of the NER depreciation on the poverty indices in the nationwide and the regional markets. To perform this, we used the Foster-Greer-Thorbecke (FGT) class of poverty measures that may be written as:

$$P_a = \frac{1}{N} \sum_i [(Y - INC_i)/Y]^a \quad (18)$$

Where,  $P_a$  is poverty index,  $N$  is total population,  $Y$  poverty line and  $INC_i$  is the income of household  $i$  (which is

equal to  $Y_r$  multiplied by family size) and the summation is limited to households. In Equation (18),  $P_0$  is simply the incidence of poverty i.e. the proportion of households falling below the poverty line,  $P_1$  is the poverty gap index defined as the incidence of poverty multiplied by the gap between the poverty line and the average income among the poor, and  $P_2$  is an index of the severity of poverty, taking into account not just the proportion of poor households and the average income of the poor, but also the variance of income among the poor.

## RESULTS

The IRSPEM base model sufficiently replicated the base year equilibrium prices, supplies, demands, and direction of rice flows, thus justifying its use in counterfactual simulations. On the first glance, it is useful to see the base year characters of the rice market. Table 2 presents market character in the baseline year, in which the import tariff rate was 4 percent, NER was equal to 0.0001 US \$ per Rials, and the country's import was about 1,380 thousand tons (tt) of rice, without any exemption. Also, retail price of rice was about 2,391 US \$ per ton and total rice consumption and production were equal to 3,039.9 and 1,659.8 tt, respectively. Table 2 also reveals interregional trade positions of each region. It is obvious that only Region 1 was a net exporter and the other regions, except Region 4 that was self-sufficient, were net importer. These findings confirm the previous study of Mosavi and Esmaeili (2012). This table also shows the regional market characters which are useful for interpreting our findings.

It is notable that the model was simulated for the year 2011 when the import tariff rate became 90 percent and NER increased sharply about 40 percent. Table 3

**Table 2.** Market characters in the baseline year.

	Country	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
Total import (tt)	1380	450.9	198	234.6	230	115	151.4
In quota import (tt)	-	-	-	-	-	-	-
Over quota import (tt)	-	-	-	-	-	-	-
Retail price (US \$)	2391	2185	2371	2929	2569	2172	2017
Consumption (tt)	3039.9	725	479.1	549	466.7	372.5	447.6
Farm gate price (US \$)	2117	1627	1774	1786	1545	2016	1797
Production (tt)	1659.8	1385.6	7	3.7	236.7	4.4	22.3
Interregional Net trade (tt)	-	1111.6	-274	-310.6	0.0	-253.1	-273.9

Source: National Household Survey collected by the Iranian Statistics Center and databases available in the Central Bank of Iran, the Iranian Ministry of Agriculture, Iranian Customs Department, and the Iranian Ministry of Road and Transport.

**Table 3.** Changes in market characters compared to baseline year.

	Country	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
Total import (tt)	-1063.6	-395.9	-142.1	-183	-167.7	-68.9	-106
In quota import (tt)	210	55.0	56.0	12.3	62.3	12.3	12.3
Over quota import (tt)	106.4	0.0	0.0	39.3	0.0	33.9	33.2
Retail price (US \$)	1189	1144	1143	1145	1125	1144	1144
Consumption (tt)	-620.2	-72.9	-112.6	-121.8	-95.1	-102.4	-115.5
Farm gate price (US \$)	1086	276.2	290.7	290.7	239.5	290.7	291.2
Production (tt)	443.4	288.7	3.5	0.1	97.5	6.8	46.8
Interregional net trade (tt)	-	34.3	-26	-61.1	24.9	40.3	56.3

Source: Simulation using IRSPEM.

demonstrates change in rice market characters from baseline. Nationwide, the total import would reduce about 1063.6 tt, decreasing from 1,380 tt in the baseline to 316.4 tt after rapid increase in NER. These results also indicate that increasing NER would raise the national average retail price and total production of rice about 1,189 US \$ per ton and 443.4 tt, respectively. It means that after increasing import tariff, retail price increases about 49.7 percent and rice production grows about 26.7 percent. Comparing these results with those found by Mosavi and Esmaili (2011) reveal that depreciation of the NER has no effect on production of rice: Mosavi and Esmaili (2011) found that only increasing rice import tariff would raise the average retail price and production of rice about 20.7 and 26.7%, respectively. It is obvious that NER depreciation merely increased retail price of rice in the country. As expected, rice

consumption is adversely affected by depreciating the NER. Rice consumption decreases about 20.4 percent (620.2 tt) amounting to 2,419.7 tt. However, the effects vary by regions. Lowest retail price increase occurs in Region 4, as the second ranked production region, at about 1,125 US \$ per ton. Also, all other regions experience modest price increase, reaching 1,144 US \$ per ton.

In contrast, Region 1 is accompanied by higher farm gate price increase about 1,086 US \$ per ton. Region 1 is associated with higher production and consumption as well, however, production not only is large enough to cover regional consumption but also secures about 1,111.6 tt for exporting to other regions. Also, results showed that only Region 1 is a net exporter region in the baseline year and its export to other regions increases about 34.3 tt as NER decreases. Region 4 has net marketable excess supply



about 24.9 tt. Depreciation of the NER leads to production rise in Region 4 about 97.5 tt and alters this region as an autarkic to a net exporter. Other regions are net importer before and after increasing import tariff; however, interregional import into Regions 2 and 3 increases (26 and 61.1 tt, respectively), but it decreases in Regions 5 and 6 by about 40.3 and 56.3 tt, respectively.

In addition, results showed that the share of all regions from imported rice would decrease especially in Region 1 (395.9 tt) which is far from world market and has a potential to secure regional consumption. As discussed before, Regions 5 and 6 are far from Region 1 and are closer to world market, therefore, increasing the average domestic rice price by about 1,144 US \$ per ton results in substitution of cheaper imported rice with domestic counterpart. Therefore, these two regions experience the lowest import decrease in comparison with other regions. Other regions are faced with the modest reduction of imported rice in the range of 142.1-183 tt.

Due to the regional differences which became apparent in Table 4, it is expected that welfare indices be differed among regions. Table 4 presents welfare changes due to the NER depreciation based on Equations (13)-(17).

As shown in Table 4, as a result of the NER depreciation, the consumer surplus

decreases about 1,405.9 million US\$ and producer surplus increases about 638.5 million US \$. Also, government obtains tariff revenue (233 million US \$) and tariff rate quota rent (120 million US \$), a total benefit of 353 million US \$ after depreciation of NER. As can be seen, rice producers and government would be better off at the expense of consumers; however, the sum of producer and government surpluses is still much lower than consumer loss, which brings a loss in total social welfare of about 442.2 million US \$. Table 4 demonstrates the effects of NER shock on the poverty indices as well. At the national scale, depreciation of NER would slightly raise poverty incidence (0.01), poverty gap (0.14), and severity of poverty would equal 1.1. As revealed in Table 3, the absolute amount of production increase happened in Region 1 and, therefore, it is clear that the producer surplus increment (528.3 million US \$) are much greater than those in the other regions. The producer gain is over 1.73 times of consumer loss and brings about the net social welfare gain (242.8 million US \$) in this region. The social welfare of Region 4 is negative (135.9 million US \$) since the consumer loss exceeds the producer gain, even though this region was identified as a net exporter after depreciation of NER. All other regions would experience only minor producer surplus increase (between 1.1-20.5

**Table 4.** Changes in welfare and poverty indices compared to the baseline year.

	Country	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
Consumer surplus (US \$)	-1405.9	-304.7	-219.5	-293.9	-218.0	-176.1	-193.6
Producer surplus (US \$)	638.5	528.3	3.1	1.1	82.1	3.3	20.5
Tariff revenue (US \$)	233	-	-	-	-	-	-
Tariff rate quota rent (US \$)	120	-	-	-	-	-	-
Social welfare	-442.4	223.6	-216.5	-292.7	-135.9	-172.8	-173.1
Poverty Incidence	0.01	-0.02	0.01	0.01	0.01	0.01	0.01
Poverty Gap	0.14	-0.2	0.2	0.2	0.2	0.2	0.2
Poverty Severity	1.1	-1.2	0.9	0.7	0.8	1.1	1.3

Source: Simulation using IRSPPEM and National Household Survey collected by the Iranian Statistics Center.



million US \$) while consumer surplus would sharply decrease (between 176.1 and 293.9 million US \$). This fact incurs social welfare loss in these regions. Effects on poverty are the same among the regions. Table 4 demonstrates that only in Region 1 depreciation of NER leads to reduced poverty, however, in all other regions this shock results in increased poverty.

Considering income as an exogenous variable in IRSPEM enables us to investigate the effect of NER depreciation on the income. Table 5 presents the income effect of raising rice import tariff in the country and in the regions. The increase in production by 443.4 tt (Table 3) would cause 633.3 million US \$ growth in total nominal income.

In addition, increase in retail price by 1,189 US \$ per ton (Table 3) not only decreases consumption, but also increases CPI by 1.89 percent. The countrywide increase in CPI, in turn, would decrease real income and per capita income about 1,010.3 million US \$ and 11.8 US \$, respectively. The NER shock promotes nominal income and CPI while reducing real income at the regional scale. However, by adopting this policy, real and per capita income would rise only in Region 1. In line with the social welfare indexes, which are mentioned in Table 4, other regions' conditions would be deteriorated by diminishing real and per capita income after depreciating the NER.

## DISCUSSION

Sudden depreciation of the NER in late 2011 and early 2012 has resulted in a significant challenges in Iran's economy.

Hence, the present research tries to study devaluation effects on rice market, using a spatial price equilibrium model. After the Philippines, Iran is the second largest rice importer in the world, importing a great deal of rice from countries such as India, Pakistan, and Vietnam to meet the domestic needs. Therefore, it is expected that the collapse of NER affect the social welfare though modifying rice import pattern. The results of this research suggested that NER collapse resulted in lower rice import, increase in retail price, and also decrease in consumption. Increase in retail price is transmitted to the farm level and increases farm gate price of rice. The results of this study confirm conclusions of Moteiee (1995) because it was shown that the NER depreciation merely decreases the consumption and has no effects on production. Hence, the NER devaluation effects are modified by contraction of the demand side i.e. reducing imports and consumption, in rice market, which was ignored in previous studies throughout the world. Also, results indicated that during tariff exemptions, due to the import barriers, the import size decreases compared to the time before tariff exemptions. The regional effects of the NER depreciation vary depending on the region being a net exporter or a net importer. It was observed that, Region 1, which has marketable surplus for exporting to other regions, would be better off. Region 4, also, changes from a self-sufficient supplier to a net exporter after depreciation. Other regions will remain as rice importers.

Changing in prices as well as values, would change the welfare of market factor. It was observed that, depreciation of the

**Table 5.** Changes in income indices compared with the baseline year.

	Country	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
Total income (US \$)	633.3	588.4	1.9	0.3	48.6	3.4	20.8
Consumer price index (US \$)	1.89	2.1	2.0	1.8	1.7	1.8	1.9
Real income (US \$)	-1010.3	254.2	-262.6	-362.8	-219.9	-207.1	-212.0
Real per capita income (US \$)	-11.8	30.7	-23.5	-21.0	14.52	-21.9	-20.8

Source: Simulation using IRSPEM.



NER decreases consumers' welfare, but increases the producers' welfare. Also, frontiersman's cooperatives benefit from tariff rate quota rent due to tariff exemption and, also, the government benefits from the tariff revenue. However, increase in producers' welfare and frontiersman's cooperatives and government income is not much to compensate the consumers' welfare. Therefore, the overall social welfare decreases. Similar results were obtained on poverty. The NER collapse in the country not only increases the number of households below the poverty line, but also worsens the poverty in the case of the poor and increases the income variations in the poor families. In a regional scale, Region 1 benefits from the NER depreciation and, subsequently, poverty in this region is decreased. In other regions, as well as the whole country, NER collapse shock intensifies the state of poverty.

On the other hand, increase in retail prices had two different effects. On the one side, the farm gate price increases, which ultimately increases the production income. On the other side, consumer price index increases and leads to inflation. Results suggested that depreciation of the NER resulted in decrease in real income and real income per capita in the entire economy and regional markets, with an inflation of 1.89 percent in rice market, except in the Region 1 markets.

Considering the findings of this research, the detrimental effect of the NER collapse on imported crops markets like rice is confirmed. This shock changes the welfare in favor of the government and producers, and to the detriment of consumers. Also, it is expected that the recent collapse in NER decreases the per capita income and increases the various aspects of poverty. The findings of this research disprove the opinions of the imports exemption critics. Applying or increasing the import tariff exemptions not only increase the import quantities, but also increase the income for individual importers benefiting from exemptions.

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### ارزیابی آثار اقتصادی کاهش نرخ ارز بر بازار برنج ایران

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#### چکیده

در سال‌های اخیر ایران کاهش شدید نرخ ارز اسمی را تجربه کرد. اثر نهایی چنین کاهش در ارزش پول ملی بر رفاه و توزیع درآمد خانوارهای ایرانی به موضوعی چالش برانگیز مابین محققین و سیاست‌گذاران تبدیل شده است. بر این اساس مطالعه‌ی حاضر آثار اقتصادی کاهش نرخ ارز اسمی را در بازار برنج با استفاده از یک مدل تعادل فضایی مورد بررسی قرار داده است. نتایج نشان داد که کاهش نرخ ارز اسمی کشور در مجموع زیان آور است. رفاه اجتماعی همگام با کاهش ارزش پول داخلی کاهش می‌یابد. این شوک هم چنین درآمد واقعی و درآمد سرانه را کاهش می‌دهد و شدت و شکاف فقر را افزایش می‌دهد. هم چنین آثار منطقه‌ای کاهش ارزش پول ملی متفاوت است و بستگی به خریدار و یا فروشنده‌ی خالص بودن هر منطقه دارد. این مطالعه با لحاظ کردن آثار درآمدی و نیز معافیت‌های وارداتی مساعدت‌ایی به ادبیات تحقیق دارد.