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An Empirical Analysis of Strategic Competition and Exchange Rate Pass-through

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Abstract

The aim of this article is to study the firm-level pricing behavior based on the firm's competitive strategy through the exchange rate pass-through. Using Iranian export price microdata, we provide new empirical evidence on how firm's exchange rate pass-through depends on firm's strategic decisions of competition. After classifying firms in two groups based on their competitive strategies, we show that firms involving in strategic complements pass more exchange rate movements to export prices than firms with strategic substitutions. Furthermore, firms in strategic substitutions tend to increase their export volume significantly more than the firms in strategic complements as a result of the depreciation of exchange rate.

1. Introduction

The fact that the real exchange changes between the trading countries transfer by a smaller proportion to the prices of traded goods has been documented by a large number of empirical studies. We define the exchange rate as a unit of home currency denominated in a unit of foreign currency. Due to incomplete pass-through the consumer price in the importing country increases less than the depreciation of exchange rate in the exporting country. This fact that condition that has been called Pricing-to-Market (PTM) has taken a lot of consideration in the literature, and there are a lot of empirical studies which explore the incompleteness of exchange rate pass-through and different behavior of the firms on the extent of pass-through. Earlier studies focused more on the exchange rate pass-through at the level of industry (Barhoumi, 2006; Bergin & Feenstra, 2009; Coulibaly & Kempf, 2010; Menon, 1996). They

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confirmed that the exchange rate pass-through was different across products and countries. More recent studies have been more concerned with the various extent of pass-through across firms (Goldberg & Hellerstein, 2007; Gopinath & Itskhoki, 2010; Gopinath & Rigobon, 2008; Martin & Rodriguez, 2004).

Models considering incomplete pass-through at the firm level are different regarding their explanations for how the degree of pass-through differs across firms. First, in models that do not consider the firms' strategic decisions, the incompleteness of pass-through comes from the firm size and fixed costs. Among them, Bernard et al. (2003), Melitz (2003), and Melitz and Ottaviano (2008) are some of the representative models which show that exposure to trade motivate the more productive firms toward the export market while some less productive firms just produce for the domestic market, and the least productive firms which cannot compete with the other firms exit the market. Based on these models (Berman et al., 2012; Chatterjee et al., 2013), result that larger and more productive firms have higher mark-ups and lower pass-through.

Secondly, there are models focusing on some forms of imperfect competition and strategic decisions of firms, which highlight higher mark-ups for more productive firms. In this context, models have been categorize into two groups: Models with Bertrand competition, like Fisher (1989) and Garetto (2016), and models with Cournot competition, like Amiti et al. (2014), Atkeson and Burstein (2007), and Auer and Schoenle (2016). Firm-level pass-through in these models is shown to be a U-shaped function of the firm productivity and size. the intuition behind that is a very large (the most productive) firm can fully pass through the cost changes as it does not fear external competition, while the smallest firm pass through cost shocks fully as has no market share to lose, and, finally, the firms with intermediate market share just partly increase prices and reduce their mark-ups to prevent losing their market share.

This article makes a contribution to the literature through the latter analysis in which the incompleteness of pass-through comes from the firm's strategic price decisions. We assume that the intensity of competition determines the degree of pass-through that a firm faces in the export market.

According to the form of imperfect and monopolistic competition or oligopoly, there are two distinct studies in the literature. First, Krugman (1980) and Krugman (1979) were the pioneers in this regard, consider monopolistic competition and realize product differentiation as an essential factor of trade patterns and the main source of gains from trade. Secondly, in terms of oligopoly, the early works backs to Brander and Krugman (1983), Brander (1981), Brander and Spencer (2015), Shaked and Sutton (1982), and Zhou et al. (2002), who focused on intra-industry trade.

The idea that imperfect competition motivates firms to pass part of the changes in their costs to prices was first formally considered by Bulow and Pfleiderer (1983), theoretically showed that the degree of pass-through of a change in marginal cost for a monopolistic firm with a linear demand curve and constant marginal cost was always 50 percent. However, firms involving in

perfect competition do not pass any change in their marginal costs onto consumers' prices. Froeb et al. (2005), unlike Bulow and Pfleiderer (1983), demonstrate a direct relationship between the price reaction of a monopolist and the degree of pass-through. This study followed by Ten Kate and Niels (2005), and Zimmerman and Carlson (2010).

However, theoretical models differentiate clearly between competitions based on Cournot and Bertrand approach; there are no empirical studies to take firms' competition strategy into account in analyzing the exchange rate pass-through. The main aim of this research is to verify the previous theoretical predictions empirically and investigate the different implications for the degree of pass-through for firms in Bertrand and Cournot competition.

Firms follow the timing decisions as: First, firms decide to export in stage 1; then in stage 2, they should decide the degree of product differentiation, and in stage 3, competition decisions must be selected whether they choose Cournot output or Bertrand price decision. If firms decide to export, they have to pay some fixed trade cost which is up-front. After that, firms face investment decisions in differentiating products, how much a firm tends to spend on their products differentiation program. Finally, each firm decides on its competition strategy based on its price (Bertrand) or its quantity (Cournot) in either domestic or foreign market that it is involved in.

In this paper, we aim to investigate how competitive behavior impressed the pricing decisions of firms in stage 3. The measure we use to differentiate the competitive behavior of firms as either Cournot or Bertrand competition in different industries, is the strategy introduced by Sundaram et al. (1996). This measure helps us to categorize Iranian manufacturing firms involving in two Bertrand or Cournot competition. Firms with Bertrand competition follow strategic complements (SC) while firms engaged in Cournot competition choose strategic substitutes (SS) policy. We show that firms choosing SS in their competition, compared to those engaged in SC, pass less exchange rate changes in their prices and increase more their export volume to the destination countries when they face a depreciation in the exchange rate.

The rest of the paper is sorted out as follows: Section 2 presents the literature review on the exchange rate pass-through; section 3 features the methodology used in this paper to distinguish between different competitive strategies of firms; section 4 estimates the model using the Iranian firm-level data; and section 5 involves conclusions.

2. Literature Review

In this article, the influence of a firm's strategic behavior against its competitors is considered on the degree of exchange rate pass-through. We extend the literature in this regard as incomplete pass-through may originate from different factors such as the variability of mark-up, imported intermediate inputs, and non-constant returns to scale. There is strong empirical support on the response of markups to exchange rate changes. For example, Goldberg and

Knetter (1996), Hellerstein (2008), and Nakamura and Zerom (2010) studied the impact of destination on the changes of markups and concluded that it was a main determinant of the incompleteness of exchange rate pass-through. Using the Spanish firm-product level data, Martin and Rodriguez (2004) found that firms increased their markups as a result of a depreciation.

Endogenous markups have also been entered to the heterogeneous firm models in recent theoretical literature in different ways. Atkeson and Burstein (2007) and Bernard et al. (2003), respectively, assumed Bertrand and Cournot competition with variable markups. Melitz and Ottaviano (2008) considered a quasi linear-quadratic utility function with endogenous markups. Regarding the impact of the extensive margin in trade models with heterogeneous firms, Helpman et al. (2008) revealed that the extensive margin could explain the observed asymmetries existing in trade flows among countries. Bernard et al. (2009) in a study on U.S. trading flows provided an explanation that the extensive margin was the important reason for most of the changes in exports and imports. In this regard, Eaton et al. (2004), considering the destination size constant, showed that the extensive margin was responsible for 88% of any increase in the French market share. According to Rodriguez-Lopez (2011), the movements of extensive margin after an exchange rate changes affected the import prices; they concluded that each producer, considering the changes in the competitive environment and as well its own productivity, adjusts its markups.

Berman et al. (2012) showed that larger and more productive French firms absorbed more the changes in the exchange rate in markups and on average, a 10% depreciation of the exchange rate resulted in 2.5% increase in export price. Bergin and Feenstra (2009) explained that when the number of firms increases the exchange rate decreases whether it is fixed or flexible.

There are some other explanations for the incompleteness of the exchange rate pass-through. Among them, Menon (1996) showed that the emergence of multinational corporations and non-tariff barriers well explained most of the changes in the exchange rate pass-through among products. Barhoumi (2006) stated that in developing countries, the exchange rate regimes, trade barriers, and inflation regimes play were as major determinants of the differences in the exchange rate pass-through. Finally, Coulibaly and Kempf (2010) showed that in emerging countries, inflation targeting involved in a reduction in the pass-through.

The competition strategy that firms choose in the market plays also a significant role in the degree of exchange rate pass-through. Since the literature on this topic is just theoretical, in this study, we try to empirically test the theoretical predictions of the relationship between firms competition approach and the degree of exchange rate pass-through.

Recent theoretical researches have included Ten Kate and Niels (2005), which confirmed an inverse relationship between the competition level and the extent of cost pass-through in a model of Cournot with homogeneous output.

In a Cournot model, Zimmerman and Carlson (2010), using linear demand system and differentiated output, also studied the impact of market power and confirmed that lower market power leads to higher cost pass-through but observed the opposite trend in a model of Bertrand competition. According to Brander and Spencer (2015), firms involved in Bertrand competition differentiate their products more than firms involved in Cournot competition.

To analyze empirically the relationship between firm's strategic behavior and exchange rate pass-through, we need to classify firms in terms of their specific competition strategic interaction in the industry. To that end, we use Sundaram et al.'s model to categorize firms into two different types of strategic interaction. Sundaram et al. (1996) constructed a proxy to differentiate firms through the competition strategy. Using 40 quarters, including all firms with 4-digit SIC, they provided the competitive strategic measure (CSM) for firms and also used cutoff levels of -0.05 and +0.05 to describe sample firms with SS and SC. Implying that if CSM is between zero and -0.05, the competition follows SS, and if it is greater than zero and smaller than +0.05, the competition is in SC. In this regard, Lyandres (2006) using annual data and assuming that firm's value function in the short-term is constant presents a mathematical affirmation for Sundaram et al.'s index.

There are also some empirical studies focusing on the pass-through based on Iranian firm's level data. Among them, Zare Mehrjerdi and Tohidi (2014), considering Iran's saffron export price, concluded that, exporters partially absorb the exchange rate variations in order to preserve or increase market share. Rasekhi and Sheidaei (2018) found that tariff pass-through were incomplete and Iranian exporters absorbed part of the increase in the tariff rate in the markups as well higher productive firms absorb less tariff changes in their markups. Amirteimoori and Chizari (2010) concluded that Iranian exporters should focus on non-price competition for increasing their market share.

3. Model

To measure the type of strategic competition, as mentioned in the previous section, we follow Sundaram et al. (1996) approach. They represent that a firm's reaction to the marginal profits of its competitors determine firm's strategic competition, SS or SC. Regarding Sundaram et al.'s model, two firms, A and B, are duopolistic and, in an initial equilibrium, set the price in the point that marginal revenue equals the marginal cost. In response to an exogenous shock, if any of the two firms changes its strategy, this change affects both its own and the other firm's marginal profits. Then, the expected marginal profits motivate both firms to re-optimize and reach a new equilibrium. Sundaram et al. (1996) concluded that the marginal profit of firms is decreasing if they choose to re-optimize by competing through SS. On the other hand, re-optimizing by competing through SC imply that the firm's marginal profit is increasing.

To measure a firm's marginal profit, the ratio of a firm's net income derivation $(\Delta\pi^f)$ to its net sales derivation (ΔS^f) and the competitors' output

derivation (ΔS^c) are needed. The $\frac{\Delta\pi^f}{\Delta S^f}$ ratio shows a firm's total profit changes as a function of its output. Then, the coefficient of the regression between $\frac{\Delta\pi^f}{\Delta S^f}$ against ΔS^c should be computed and that gives us a direct proxy for CSM. It measures the second derivative of profit with respect to its own quantity and the competitors' quantity, $\partial^2\pi^A/\partial q^A\partial q^B$. Competition is in SS if the proxy is smaller than zero, while if CSM is greater than zero, competition is based on SC and if CSM equals to zero, implies neither SS nor SC competition strategy.

To compute CSM, we use firm-level quarterly data based on 4-digit ISIC level and assume that a firm's competitive behavior is consistent in each year in the industry. The quarterly data help us to consider if any shocks change the competitive behavior of firms.

To test the impact of a firm's strategic behavior on exchange rate pass-through for two samples of firms engaging in Bertrand and Cournot competition, we estimate estimated the equation (1):

$$lnP_{ifjt} = \alpha_p ln(RER_{jt}) + \beta_p LP_{ft} + \gamma_p (ln(RER_{jt}) \times LP_{ft}) + FE + \mu_{ifjt} \quad (1)$$

where P_{ifjt} denotes the exporter prices of product i export by firm f to country j at year t; RER_{jt} is the real exchange rate between Iran and country j during year t. LP_{ft} is the labor productivity of firm f at year t, and $ln(RER_{jt}) \times LP_{ft}$ represents the interaction between RER and firm productivity to estimate its impact on exchange rate absorption. P_{ifjt} is computed through dividing the export value by export quantity as $P_{ifjt} = \frac{V_{ifjt}}{x_{ifjt}}$, where V_{ifjt} and x_{ifjt} are, respectively, the total value and the volume of product i at HS8 which firm f exported to country j in year t. We also exclude any transactions that have missing information in quantity, destination, time, and value. We also compute the labor productivity as a proxy for TFP, measured by the ratio of value added per worker. α_p implies the percentage change in the home export price of a firm with respect to one percent change in the real exchange rate between Iran and country j; FE represents various fixed effects. Product-country-year fixed effects are applied to control specific product-country-year factors affecting export prices; therefore, just the firm level changes are explained by the model. We use fixed effects regression as we have data that categorize in terms of industry, country, and year. Therefore, in order to have more accurate results, the characteristics of such categories should be controlled. We use the country-product year fixed effects in our estimation, following the methodology proposed by Feenstra (2002) for cross-sectional data which has been widely used in the studies to control the effect of different categories (Ruiz, 2007; Berman et al., 2012; Ludema, 2016). According to the previous theoretical studies, the prediction is that exchange rate depreciation may increase the firm's export prices less than the exchange rate changes and firms engaged in Bertrand

competition may experience more changes in their price and absorb less exchange rate changes in their markups than firms with Cournot competition.

The idea that tariff changes affect firm-level export volume effect is tested by the reduced form model presented in equation (2):

$$lnx_{ifjt} = \alpha_x ln(RER_{jt}) + \beta_x LP_{ft} + \gamma_x(\Delta ln(RER_{jt}) \times LP_{ft}) + \varphi_X X + FE + \varepsilon_{ifjt} \quad (2)$$

where x_{ifjt} denotes the export volume of product i that is exported by firm f to country j in year t. X stands for the control variable, and the changes of GDP are selected as representative of X which provide a measure of the changes in the market size of the destination. We expect that the exchange rate depreciation would increase the volumes that firms export because our currency becomes cheaper for foreigners, and it is more likely that their demand increase for import.

4. Results and Analysis

In order to construct the proxy to differentiate firms in terms of competition, first, the set of competitors should be defined. All firms engaged in the industry at 4-digit level are selected as the set of competitors. Next, for firm's profit proxy, the net income is used and net sales are chosen as a proxy for firm's output and its competitors. The data are collected in two frequencies, annually and quarterly. Quarterly data includes manufacturing firm's relative information such as net incomes and net sales to estimate CSM, which are collected for 32 quarters during 2009-2017 from Codal Publishers Information System. For the annual frequency, the data for the price, quantity, and value of sales are obtained from the Islamic Republic of Iran Customs Administration (IRICA). In addition, the data for value added and the number of workers to measure LP also obtained from the statistical center of Iran.

Table 1 displays the average CSMs for the industries included in our sample. We choose 24 industries for our analysis. The remaining industries have small sample sizes in our database, which made it difficult to draw any generalizations. Therefore, we decide not to consider them in our analysis. Given the available data, some of the CSMs are as follows: Rubber tires + 0.04 (SC), basic iron and steel – 0.01 (SS), and pharmaceuticals +0.03 (SC).

The average CSM in our sample is 0.03 and since it is more than zero, implying that more firms chose SC for competition. Moreover, 54 firms have CSM>0 while 52 firms have CSM<0.

Table 1. Average Competitive Strategy Measure (CSM) in Industry

Industry	Average CSM	Industry	Average CSM
Sugar	0.00	rubber tires and tubes; retreading and rebuilding of rubber tires	004
cocoa, chocolate, and sugar	-0.05	non-structural non-refractory ceramic ware	0.11
malt liquors and malt	-0.01	structural non-refractory clay and ceramic products	-0.19
textile fibers, weaving of textiles	0.04	cement, lime, and plaster	0.02
pulp, paper, and paperboard	0.04	basic iron and steel	-0.01
basic chemicals, except fertilizers and nitrogen compounds	0.001	basic precious and non-ferrous metals	0.000
fertilizers and nitrogen compounds	0.03	general-purpose machinery	0.02
paints, varnishes, and similar coatings, printing ink and mastics	-0.21	agricultural and forestry machinery	0.10
pharmaceuticals, medicinal chemicals, and botanical products	003	domestic appliances n.e.c.	0.01
soap and detergents, cleaning and polishing preparations, perfumes, and toilet preparations	0.04	electric motors, generators, and transformers	0.02
chemical products	0.03	motor vehicles	0.003
man-made fibers	-0.06	accessories for motor vehicles and their engines	-0.001

***Source**: Author's Competition*

After measuring the average significant CSM for 24 industries, we arrange the data in two samples of firms to explore how firms with different strategies for competition pass through variations in their costs to the prices of exporting goods.

Table 2 presents a summary of the statistics for all the variables and a comparison of the mean differences across the Bertrand and Cournot samples. According to our sample, firms compete based on SCs set higher prices over their export goods while the mean for the export volume is higher for firms with SSs policy. It is also observed that firms engaged in Bertrand competition enjoy higher labor productivity.

In the last two rows of Table 2, the means of lnP and lnx between two groups of Bertrand and Cournot are compared. The null hypothesis is $H0: mean\ (Cournot) - mean\ (Bertrand) = 0$. The results show that the difference in the means between the two considered groups is different from 0.

Table 2. Summary of the Statistics (2009-2017)

Number of Firms				106		
Number of countries		28		30		
Variables	Number of Observation	Mean	Std.Dev.	Number of Observation	Mean	Std.Dev.
		Bertrand			Cournot	
lnP_{ifjt}	33104	11.07	1.39	16128	10.6	1.19
lnX_{ifjt}	33104	9.52	3.08	16128	10.47	3.38
$lnEXR_{jt}$	33104	3.65	2.79	16128	3.33	2.88
$lnLP_{jt}$	33104	6.27	0.95	16128	6.04	0.69
$lnGDP_{jt}$	33104	11.60	3.14	16128	11.60	2.95
Diff(mean)-lnP		-0.41*** (0.036)				
Diff(mean)-lnx		0.95*** (0.086)				

***Note**: Robust standard errors presented in parentheses; *, **, and *** imply 10%, 5%, and 1% significance levels, respectively.*

***Source**: Author's Competition*

Tables 3 and 4 report the estimation results of equations (1) and (2), respectively. Regarding the price estimation in Bertrand sample (Table 3, column 1), exporters significantly increase their price in response to depreciation in exchange rate. In this sample, a 10% exchange rate depreciation increase the average price of exporting firms by 0.13%. This positive prediction is also valid for exporting firms competing based on SS (Table 3, column 4), where exporting firms increase their prices %0.04 on average as a result of 10% depreciation in the real exchange rate. Note that firms involved in Bertrand competition tend to pass exchange rate changes to prices more than firms involved in Cournot competition. A product-country-year fixed effect is also used to control any specific product-country-year factors that affect export prices.

There is also a positive relationship between LP and the export prices in both samples. In Bertrand model, firms increase their prices significantly on average 2% for 1% increase in productivity. In Cournot sample, this coefficient falls to 0.4%, implying that productivity is a key factor in pricing to market for firms involved in price competition. Product-year and country-year fixed effects in columns 2 and 3 are entered to keep product-year and country-year specific shocks, affecting export prices, constant, respectively.

The results presented in columns 3 and 6 show showed that the exporter price elasticity to a real exchange rate change for both Bertrand and Cournot firms increases with performance of firms as there is a positive and significant sign on the interaction term with the real exchange rate. It is also evident that firms in Bertrand competition are more sensitive to the changes in productivity as the rate of pass-through in better performance firms is higher 0.15% rather than 0.06% in Cournot sample.

Table 3. Estimation of Exchange rate pass-through Prices

Dep.V, LnP	Bertrand Sample			Cournot Sample		
	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
lnRER	0.013** (0.006)	-	0.011* (0.006)	0.004* (0.002)	-	0.002* (0.001)
lnLP	-	2.054*** (0.227)	2.092*** (0.228)	-	0.409*** (0.145)	0.405*** (0.147)
lnRER×lnLP	-	-	0.015** (0.006)	-	-	0.003** (0.001)
Bertrand#c.lnRER1	0.008*** (0.002)	-	0.008** (0.004)	-	-	-
Bertrand#c.LP1	-	1.644*** (0.000)	1.686*** (0.000)	-	-	-
Bertrand#lnRER×lnLP1	-	-	0.011** (0.000)	-	-	-
R^2	0.40	0.40	0.40	0.51	0.51	0.51
Number of observations	33104	33104	33104	16128	16128	16128

***Note**: Robust standard errors presented in parentheses; *, **, and *** imply 10%, 5%, and 1% significance levels, respectively.*

The results of estimating equation (2) give us some interesting results regarding export volume (Table 4). We find that the response of export volumes to a depreciation of exchange rate is positive, implying that as a result of 1% exchange rate depreciation, export volumes for Bertrand sample increases on average 0.13% (column 1) while firms with SS increase their exports 0.17% for a 1% increase in exchange rate. The result shows that the export volumes of firms involved in SS are more sensitive to the exchange rate changes than firms in SC sample.

In columns (2) and (6), the estimation of the effect of labor productivity on export volume is reported. There is a positive relationship between the extent of the export and the productivity of firms; however, it is not significant. For the Bertrand sample (column 2), the elasticity of export volume to LP is 0.37%, implying that firms in average increase their exports 0.37% by 1% increase in their productivity. This increase was much more for the firms in Cournot competition as they tend to increase their exports by 2%, which show clearly the competition in production.

In both Bertrand and Cournot samples, the sign for the interaction term between LP and the real exchange rate is negative, meaning that the elasticity of the exporter volume to a real exchange rate depreciation decreases with performance.

Finally, the results show the size of importing countries as an important factor in determining the volume of exports to the destination. Firms in both samples increase their export to the destination when the size of importing countries becomes larger. Since GDP is a country-year specific variable, we

decline the country-year fixed effect and just maintain the product-year fixed effect in the estimation of columns 4 and 8.

Table 4. Estimation of Exchange rate pass-through export volume

	Bertrand Sample				Cournot Sample			
Dep.V, Lnx	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8
lnRER	0.139*** (0.015)	-	0.667*** (0.103)	0.650*** (0.142)	0.176*** (0.020)	-	1.079*** (0.171)	1.009*** (0.172)
lnLP	-	0.378 (0.586)	0.525 (0.416)	0.986 (1.972)	-	1.524 (1.283)	2.178* (1.251)	2.016 (1.229)
lnRER×LP	-	-	-0.084*** (0.016)	-0.058*** (0.022)	-	-	-0.151*** (0.028)	-0.140*** (0.028)
lnGDP	-	-	-	0.078* (0.040)	-	-	-	0.016* (0.010)
Bertrand# lnRER1	-0.036** (0.018)	-	-0.412*** (0.048)	-0.359*** (0.051)	-	-	-	-
Bertrand# lnLP1	-	-1.145*** (0.000)	-1.652*** (0.000)	-1.029*** (0.000)	-	-	-	-
Bertrand# lnRER×LP1	-	-	0.066*** (0.000)	0.081*** (0.000)	-	-	-	-
Bertrand# lnGDP1	-	-	-	0.062** (0.030)	-	-	-	-
R^2	0.18	0.20	0.21	0.33	0.58	0.57	0.59	0.61
Number of observations	33104	33104	33104	33104	16128	16128	16128	16128

***Note**: Robust standard errors presented in parentheses; *, **, and *** imply 10%, 5%, and 1% significance levels, respectively.*

To compare the significance of regression coefficients between two groups, the hypothesis $H0: \beta_b = \beta_c$, where β_b is the regression coefficients for Bertrand group and β_c is the regression coefficients for Cournot group is tested. The estimations reported in Tables 3 and 4 indicate that the regression coefficients β_b are significantly different from β_c in all considered models.

5. Conclusion Remarks

This paper aim to empirically compare the consequences of firm's strategic decisions by choosing Bertrand or Cournot competition on firm's pricing decisions. Firms differentiate their products to mitigate competition while investment in product differentiation results in a greater difference between products under Bertrand and Cournot competition. We rely on Sundaram et al. (1996) as a proxy to differentiate firms competing based on Bertrand or Cournot competition. The results imply among 106 firms under investigation, of which 54 competed based on SC. Firms with SC policy tend to pass more exchange rate variations to the exporting price than firms compete based on the SS. Furthermore, the export volume is more sensitive to the exchange rate changes in the Cournot than in the Bertrand sample. The results also indicated that the

elasticity of the exporter price to a real exchange rate change for both Bertrand and Cournot samples increases with the performance of firms. Nevertheless, the elasticity of the exporter volume to a real exchange rate change for both Bertrand and Cournot samples decreases with the performance of firms. Considering firms' competition strategies help them in their pricing decisions relative to their competitors once they face a shock like exchange rate depreciation. Furthermore, increasing the level of productivity let firms to keep their mark-ups still high when a shock happens in their costs as there are asymmetric effects of exchange rate movements on firms' behavior with different competition strategies and different levels of productivity.

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Appendix

Table 5. The list of countries considered in the empirical estimation

Main Importing Countries	ISIC	Main Importing Countries	ISIC
Spain, Australia, Afghanistan, Emirates, England, Italy, Azerbaijan, Germany, Bahrain, Pakistan, Tajikistan, China, Iraq, Oman, Russia, Kyrgyzstan, Kazakhstan, Qatar, Canada, Kuwait, Georgia	1542	Jordan, Armenia, Afghanistan, Emirates, England, Italy, Azerbaijan, Germany, Pakistan, Tajikistan, Turkey, Republic of Korea, China, Iraq, Oman, Russia, Kyrgyzstan, Kazakhstan, Qatar, Kuwait, Georgia, Malaysia, Netherlands, India	1543
Armenia, Australia, Afghanistan, Emirates, England, Ukraine, Italy, Azerbaijan, Bahrain, Pakistan, Tajikistan, Turkey, Republic of Korea, China, Iraq, Oman, Russia, Kyrgyzstan, Kazakhstan, Qatar, Canada, Kuwait, Georgia, Malaysia, India.	1711	Armenia, Afghanistan, Italy, Pakistan, Tajikistan, Turkey, Iraq, Oman, Qatar, Kuwait, Malaysia, India	1533
Armenia, Afghanistan, United Arab Emirates, United Kingdom, Italy, Germany, Pakistan, Tajikistan, Turkey, Republic of Korea, China, Iraq, Oman, Russia, Kyrgyzstan, Kazakhstan, Qatar, Kuwait, Georgia, Malaysia, India	2101	Armenia, Spain, Afghanistan, United Arab Emirates, United Kingdom, Ukraine, Italy, Azerbaijan, Pakistan, Tajikistan, Turkey, Republic of Korea, China, Iraq, Oman, Russia, France, Kyrgyzstan, Kazakhstan, Qatar, Georgia, Malaysia	2422
Armenia, Spain, Afghanistan, UAE, Indonesia, United Kingdom, Ukraine, Italy, Azerbaijan, Germany, Pakistan, Turkey, Republic of Korea, China, Iraq, Oman, Russia, Kyrgyzstan, Kazakhstan, Qatar, Kuwait, Georgia, Malaysia, India	2411	Armenia, Spain, Afghanistan, UAE, Italy, Azerbaijan, Tajikistan, Turkey, Romania, Iraq, Oman, Russia, Kyrgyzstan, Georgia, Poland	2430
Armenia, Spain, Afghanistan, UAE, Azerbaijan, Pakistan, Tajikistan, Turkey, Republic of Korea, China, Iraq, Oman, Kazakhstan, Kuwait, Georgia, Malaysia, India	2412	Armenia, Afghanistan, United Arab Emirates, United Kingdom, Azerbaijan, Tajikistan, Turkey, Republic of Korea, Romania, Iraq, Oman, Russia, Kazakhstan, Qatar, Kuwait, Georgia, Poland, Netherlands	2692
Armenia, Afghanistan, UAE, Ukraine, Italy, Azerbaijan, Germany, Pakistan, Tajikistan, Turkey, Republic of Korea, China, Iraq, Oman, Russia, Kazakhstan, Qatar, Kuwait, Georgia, Malaysia, India	2423	Jordan, Armenia, Spain, Afghanistan, United Arab Emirates, United Arab Emirates, Ukraine, Italy, Azerbaijan, Germany, Pakistan, Tajikistan, Turkey, Republic of Korea, China, Iraq, Oman, Russia, France, Kyrgyzstan, Kazakhstan, Qatar, Kuwait, Georgia, Poland , Malaysia, Egypt, Netherlands, India	2710

Table 5(Continued). The list of countries considered in the empirical estimation

Main Importing Countries	ISIC	Main Importing Countries	ISIC
Armenia, Australia, Afghanistan, UAE, Indonesia, United Kingdom, Ukraine, Italy, Azerbaijan, Germany, Bahrain, Pakistan, Tajikistan, Turkey, Republic of Korea, China, Iraq, Oman, Russia, Kyrgyzstan, Kazakhstan, Qatar, Canada, Kuwait, Georgia , Malaysia, India	2424	Armenia, Spain, Afghanistan, UAE, UK, Ukraine, Italy, Azerbaijan, Germany, Tajikistan, Turkey, Republic of Korea, China, Romania, Iraq, Russia, France, Kyrgyzstan, Kazakhstan, Kuwait, Georgia, Poland, Egypt, India	3430
Armenia, Spain, Afghanistan, United Arab Emirates, United Kingdom, Ukraine, Azerbaijan, Germany, Pakistan, Tajikistan, Turkey, Republic of Korea, Iraq, Oman, Russia, Kyrgyzstan, Kazakhstan, Qatar, Canada, Kuwait, Georgia, Malaysia	2429	Armenia, Spain, Australia, Afghanistan, UAE, Indonesia, United Kingdom, Italy, Azerbaijan, Germany, Bahrain, Pakistan, Turkey, Republic of Korea, China, Iraq, Oman, Russia, Kyrgyzstan	2720
Armenia, Afghanistan, UAE, Indonesia, Azerbaijan, Germany, Pakistan, Tajikistan, Turkey, Republic of Korea, China, Iraq, Oman, Kyrgyzstan, Kazakhstan, Kuwait, Georgia, Malaysia, India	2511	Armenia, Australia, Afghanistan, United Arab Emirates, United Kingdom, Italy, Azerbaijan, Germany, Bahrain, Pakistan, Tajikistan, Turkey, Republic of Korea, China, Iraq, Oman, Russia, Kyrgyzstan, Kazakhstan, Qatar, Kuwait, Georgia, India	2919
Armenia, Spain, Australia, Afghanistan, UAE, Italy, Azerbaijan, Germany, Tajikistan, Turkey, China, Iraq, Oman, Russia, Kyrgyzstan, Kazakhstan, Qatar, Kuwait, Georgia, India	2691	Armenia, Spain, Afghanistan, UAE, Indonesia, England, Italy, Azerbaijan, Germany, Pakistan, Tajikistan, Turkey, Iraq, Oman, Russia, Kyrgyzstan, Kazakhstan, Qatar, Canada, Kuwait, Georgia, India	2921
Armenia, Afghanistan, UAE, Pakistan, Iraq, Oman, Kuwait, Kyrgyzstan, Kazakhstan, Qatar, Georgia, India	2694	Armenia, Spain, Australia, Afghanistan, UAE, UK, Ukraine, Italy, Azerbaijan, Germany, Bahrain, Tajikistan, Turkey, Republic of Korea, Iraq, Oman, Russia, Kyrgyzstan, Kazakhstan, Qatar, Canada, Kuwait, Georgia, Malaysia	2930
Armenia, Spain, Afghanistan, UAE, Italy, Azerbaijan, Germany, Tajikistan, Turkey, Republic of Korea, China, Iraq, Russia, India	3410	Armenia, Afghanistan, UAE, Italy, Azerbaijan, Germany, Tajikistan, China, Iraq, Kazakhstan, Kuwait, Georgia, India	3110

Table 6. Unit Root Results Fisher-type

Variable	ADF	PP
Ln(P)	-0.099 (0.89))	-0.225 (0.38)
Ln(X)	-0.245 (0.79)	-0.551 (0.35)
Ln(EXR)	-0.094 (1.00)	-0.134 (1.00)
Ln(LP)	-0.201 (0.96)	-0.473 (0.55)
Ln(GDP)	-0.064 (0.99)	-0.162 (1.00)
Dln(P)	-6.907 (0.00)	-2.862 (0.00)
Dln(X)	-6.456 (0.00)	-4.460 (0.00)
Dln(EXR)	-2.988 (0.00)	-0.681 (1.00)
Dln(LP)	-3.568 (0.00)	-4.669 (0.00)
Dln(GDP)	-2.978 (0.00)	-3.708 (0.00)

***Notes**: The null hypothesis contains unit roots. ** indicates the parameter is significant at the 5% level.*

Table 7. Kao Cointegration Test

	t-statistic	Prob
ADF Model 1	-5.02***	0.00
ADF Model 2	-3.75***	0.00

***Notes**: The null hypothesis is that there is no cointegration. *** indicates that the parameter is significant at the 1% level. Model 1 refers to the exchange rate pass-through prices, and Model 2 refers to the exchange rate pass-through export volume.*

Table 8. Fisher-Type Test

		Trace Statistic	Prob	Max-Eigen Statistic	Prob
Model 1	None	849.4**	0.00	350.0**	0.00
	At most 1	499.4**	0.00	210.3**	0.00
	At most 2	289.1**	0.00	195.6**	0.00
	At most 3	93.44**	0.00	89.1**	0.00
Model 2	None	298.1**	0.00	156.9**	0.00
	At most 1	141.1**	0.00	85.97**	0.00
	At most 2	55.19**	0.00	52.85**	0.00
	At most 3	2.333	0.12	2.333	0.12

***Notes**: *** shows that test statistics are significant at the 5% level. Model 1 refers to the the exchange rate pass-through prices, and Model 2 refers to the exchange rate pass-through export volume.*

Table 9. Fixed-effects test

	F-test	df	Prob
Model 1	31.68	(23,49229)	0.00
Model 2	39.18	(23,49228)	0.00

***Notes**: F test result the rejection of poolability and selection for the fixed effects model. Model 1 refers to the exchange rate pass-through prices, and Model 2 refers to the exchange rate pass-through export volume.*

Table 10. Hausman fixed random test

	Chi2 (df)	Prob
Model 1	42.31 (3)	0.00
Model 2	21.52 (4)	0.00

***Notes**: The results show that fixed effect model is appropriate. Model 1 refers to the exchange rate pass-through prices, and Model 2 refers to the exchange rate pass-through export volume.*