Tariff Pass-through and Firm's Productivity: A Case Study of Iran[1]

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Abstract

This paper investigates the heterogeneous reaction of Iranian exporters to the tariff rate changes and how export prices are influenced differently by the increase or decrease in foreign importers' tariff rates. Using the Iranian transaction level export data and firm-level data from 2002 to 2015, we find that tariff pass-through for Iranian firms is incomplete, and exporters absorb part of the increase in tariff rate in their markups. The results also reveal an inverse relationship between the tariff absorption elasticity and firm productivity, as higher productivity firms absorb fewer tariff changes in their markups and pass most of it into their prices than lower productive firms. There is the same finding on the relationship between export volume elasticity relative to tariff changes and a firm's productivity.

Keywords: Tariff Pass-through, Firm's Productivity, Heterogeneity, Fixed Effect, Markup.

JEL Classification: F00, D22, F1.

1. Introduction

The effect of tariff rate changes on trade prices has been known as tariff pass-through in the literature. Tariff pass-through can either be complete or incomplete if consumer prices change as much as tariff change, or less than the full amount of a tariff change. The magnitude of tariff pass-through is important since it is one of the sources of the effect of tariff changes on national welfare. For example, when a

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country raises its tariff on a product, foreign exporters to that country may absorb part of the tariff increase by lowering their export prices, thus improving the home country's terms of trade. Empirical evidence on the relationship between trade policy and terms of trade is considerable (Bagwell & Staiger, 2004, 2011; Broda, Limao, & Weinstein, 2008; Campolmi, Fadinger, & Forlati, 2014; Garred, 2018; Idrisov, Ponomarev, & Sinelnikov-Murylev, 2016; Ludema & Mayda, 2013). But the extent by which tariff rate changes pass through to consumer prices was analyzed theoretically by Katrak (1977); Svedberg (1979) and Brander and Spencer (1984), they find that exporting firms do not change consumer prices in full correspondence with tariff changes, and profit maximizing exporting firm usually decreases (increases) its price when a tariff is increased (decreased), therefore tariff is less than fully passed through to consumer prices. The study was followed by (Atkeson & Burstein, 2008; Berman, Martin, & Mayer, 2012; Han, Liu, Marchand, & Zhang, 2016; Ludema & Yu, 2016; Melitz & Ottaviano, 2008).

Tariff changes affects trade prices through various channels which can be driven by changes in the exporters' markup, consumer prices, qualities or compositional effects, such as heterogeneous price response at the firm level or reallocation of market shares between firms with different prices. The literature on heterogeneous firms in international trade is the natural starting point on pass-through at the firm-level. As Melitz (2003) model of heterogeneous firms, predicts that a change in trade conditions causes a change in the variety of goods that are traded. However, the basic Melitz (2003) model is not well suited to studying tariff pass-through behavior, as it assumes constant marginal cost and CES utility, which imply constant markups and complete tariff pass-through at the firm level. Heterogeneous firm models with endogenous markups predict that exchange rate pass-through will vary with productivity. The most relevant empirical work in this regard is Berman et al. (2012) on the exchange rate pass-through behavior of French firms. They find that lower-productivity exporters' firm exhibit greater exchange rate pass-through, and their finding is in line with the linear demand and variable-markups model of Melitz and Ottaviano (2008). Ludema and Yu (2016) also explore the pass through of tariff to prices for U.S. export prices according to

firm productivity and endogenous product quality and find that firms respond to foreign tariff reductions by upgrading product quality and increasing prices, resulting in incomplete tariff pass-through.

Factors such as market structure, the degree of competition and firm's productivity may also impact tariff pass-through. Heterogeneous firm models that incorporate product quality into CES utility, such as Baldwin and Harrigan (2011); Kugler and Verhoogen (2011); Mandel (2010) and Gervais (2015) predict that the most productive firms have the highest prices since they produce high quality goods. Notably, Manova and Zhang (2012) shows that more successful exporters use higher quality inputs to produce higher quality goods and that firms are quite flexible in adapting quality across destinations depending on market characteristics. In addition, demand for a high quality product may have a different elasticity than demand for a low-quality product, resulting in a different rate of pass-through. That is, customers who buy low-quality products may simply be more price sensitive than those who buy high-quality products.

Soderbery (2014) develops a model of international trade where firms are heterogeneous across capacity and productivity. He concludes that changes in the structure of firm' implicit marginal cost through fluctuating trade barriers and market size endogenously impact their production and pricing decisions. Han et al. (2016) study how market structure, especially the size of the private sector, affects tariff pass through and result that a higher share of private sector in Chinese cities is associated with higher levels of tariff pass-through rates.

Our paper is closely related to the literature on pass-through and heterogeneous firms based on the model of (Melitz & Ottaviano, 2008) of firm heterogeneity and variable markups. We try to explore the degree of tariff pass through at the Iranian firm level and investigate how the response of export prices to the changes in tariff rate depends on firm heterogeneity in productivity and product differentiation in quality. This is the first study to test if the tariff pass-through of Iranian exporters differs by productivity items. Using Iranian transaction-level export data, firm level manufacturing data and measures of scope for quality differentiation, we find evidence in support of incomplete tariff pass-through in Iranian exporters' firms

and an inverse relationship between the tariff absorption elasticity and firm productivity for products with high quality scope, and the reverse for products with low quality scope.

The next section briefly discusses the related literature on tariff pass-through and heterogeneous firm models. Section3 describes the methodology and Section4 presents data, how items are separated into low-and high productivity and empirical results. Section5 concludes.

2. Literature Review

Much of the early research on the concept of incomplete pass-through in bilateral trade was primarily concerned with the pass-through of exchange rate fluctuations to consumer prices. Kreinin (1961) was the first who studied the effect of the United States' tariff reductions on the volume and prices of imports from 1954 to 1959, and concluded that part of the tariff concessions during this period were absorbed by foreign producers rather than passed on to U.S. consumers. A pioneering empirical work on this issue is Feenstra, Romalis, and Schott (2002), who identified the symmetric pass-through between tariff rates and exchange rates in the long-run in U.S. imports from Japan. He finds that around 40 percent of the U.S. tariff increase against Japanese truck imports in the 1980s was absorbed in lower Japanese export prices. Similar results are found in different setting by Mallick and Marques (2008) and Irwin (2014).

Most recently, studies of tariff pass-through have focused on nations experiencing liberalization from 1990 onward. Among them Mallick and Marques (2008) found incomplete tariff pass-through for India's trade liberalization in the 1990s. This study and many others (Anson et al., 2005; Cheong, Kwak, & Tang, 2018; Cirera, 2014; Olarreaga & Özden, 2005; Özden & Sharma, 2006; Soderbery, 2018; Winters & Chang, 2000) have focused on the effect of preferential tariff rates such as regional trade agreement (RTA) rates. According to Soderbery (2018), optimal tariff are positively correlated with applied tariffs across a plethora of dimensions of the data. The data display intuitive patterns of importers targeting goods that generate pronounced terms of trade gains with higher tariff rates. Bouvet, Ma, and Van Assche (2017) examine whether a firm's import content share differently affects the degree of tariff and exchange rate pass-

through into its export price. The model suggest that a firm's import content share negatively affects the degree of exchange rate pass-through but does not affect the degree of tariff pass-through. Duso and Szücs (2017) analyze the pass-through of cost changes to retail tariffs in the German electricity market and pass through rate of independent firms is significantly higher than that of other firms in the competition market segment, where the extent of supply-side heterogeneity is limited. Thus, the firms' ability to exercise market power and reduce pass-through appears to be constrained by competition and largely determined by demand side factors.

Furthermore, To estimate tariff pass through while all the above studies have analyzed the issue at a product level, for example, Mallick and Marques (2008) for an analysis at the 2-digit SITC level, Winters and Chang (2000) at the 5-digit SITC level) and Blonigen and Haynes (2002); Pompelli and Pick (1990) for a single good. Görg, Halpern, and Muraközy (2017); Ludema and Mayda (2013) and Ludema and Yu (2016) examined the tariff pass-through at the firm level for Hungarian and U.S exports respectively. The previous literature has generally found that tariff pass-through is incomplete, but variations in quality may bias these pass-through estimates.

The role of quality adjustments as a determinant of incomplete tariff pass-through has been explored by some recent works. Melitz and Ottaviano (2008) show in a theoretical heterogeneous firm model that exporting firms adjust both markups and the quality of their goods in response to a tariff change. Their model is based on a linear demand system with horizontal product differentiation which implies that the price elasticity of demand increases with the price faced by consumers. On the other hand high productive firms face a lower demand elasticity, therefore when the cost of production fall for all exporters in the home country, the exporters increase their markup on their destination so that there is pricing to market and incomplete pass-through of changes in costs to export prices. Atkeson and Burstein (2008) set up a model with Cournot competitors, faced with a nested CES demand over several sectors and assume that higher performance firms have larger market shares in a sector and lower demand elasticity. They show that firms with a larger market share set higher prices in response to a real exchange rate change. Ludema and

Mayda (2013) find that differences in pass-through are based on the extent of product differentiation and firm productivity level. Using an extension of Melitz and Ottaviano (2008), they show that exporting firms absorb tariff changes not only by adjusting their markups due to the linear demand structure, but also by adjusting the quality of their products.

There are some Iranian studies that focus on pass-through in the literature. Among them Taiebnia and Rahimi (2008) show that pass through is incomplete and the impact of exchange rate shock on the import prices is higher than the impact on wholesale and consumer prices. Rasekhi (2016) investigates the rate and decisive factors of cost transferring of 114 manufacturing industry in four-digit ISIC level. The results show that among the factors, concentration ratio and economies of scale have positive and meaningful effects. Yazdani (2018) examines pass-through effects on domestic prices among Japan, Korea, Iran and Turkey and confirms a dynamic relationship between exchange rate pass-through and macro variables. He also shows that the pass-through shocks in the short-run are more effective in the countries with floating exchange rate regime and inflation targeting policy.

This paper tends to use Iranian disaggregated data for the Iranian manufacturing firms to study the impact of firm's productivity on tariff pass-through.

3. Firm-level Methodology

To test the impact of tariff changes on export price, the degree of tariff pass-through, and the impact of firm's productivity on tariff absorption, first we estimate the following specification:

$$lnP_{ifct} = \beta TFP_{ifct} + \delta_{ict} + u_{ifct} \tag{1}$$

where lnP_{ifct} denotes the log price of product i exported by firm f to country c in the period t. TFP_{ifct} is the high productivity dummy that is set to 1 if the TFP of the exporting firm f in the year t is higher than the average TFP of all firms exporting the same product i to the same destination country c, and 0 otherwise. δ_{ict} stands for a product-

country-year fixed effect, and u_{ifct} is the error term. We use a product-country-year fixed effect to control any product-country-year specific determinants for export prices, so that the only variation in export prices unexplained by this fixed effect is the firm level variation. In this specification, coefficient β measures the price-productivity schedule, i.e., how export prices are related to firm productivity: if β is negative, then the products, on average, are quality homogeneous; if β is positive, then the products, on average, are quality differentiated.

Our testable prediction is that firms of home country (Iran) react to tariff rate movements by absorbing part of them in their export price, and the less so the higher the performance of the firm. In models with heterogeneous pricing-to-market, the optimal production price depends on the marginal cost of the firm, which itself depends on its specific productivity draw and on other types of marginal costs (wages) that are common to all exporters. It also depends on bilateral trade cost and tariff rate. We therefore use the following specification to test the impact of tariff changes on export prices and the role of productivity on this pass-through:

$$\Delta lnP_{ifct} = \alpha_p\Delta ln(\tau_{ict}) + \beta_pTFP_{ifct} + \gamma_p\big(\Delta ln(\tau_{ict}) \times TFP_{fict}\big) + \varphi_pX + FE + \mu_{ifct} \qquad (2)$$

where $\Delta ln(\tau_{ict})$ is the log change of tariff rate of country c imposed on its imports of product i from Iran.

α_p is the firm-level tariff absorption elasticity, defined as $\alpha_p = -\partial\ln(p)/\partial ln(\tau)$. This measures the percentage increase in a home firm's export price in response to a one percent decrease in the foreign tariff. The prediction is a decrease in the foreign tariff increases the export price of every home exporting firm which show that firm level tariff pass-through is incomplete.

$\Delta ln(\tau_{ict}) \times TFP_{fict}$ represents the interaction between TFP and firm productivity to estimate its impact on tariff absorption. For quality differentiated goods, it is expected that the firm-level tariff absorption elasticity may decrease with firm productivity. This may occur because high productivity firms have higher initial prices, which

dampens their percentage response to changes in the foreign tariff.

X stands for a set of control variables and FE represents various fixed effects. Our prediction is that firms of home country (Iran) response to tariff changes by absorbing part of them in their export price and the more productive firm is the less absorption is expected. We also consider the bilateral exchange rate between Iran and its partner countries and GDP of foreign countries as control variables.

The effect of tariff changes on firm-level export quantity is studied using the same reduced-form strategy as for prices, estimating the following equation:

$$\Delta lnx_{ifct} = \alpha_x \Delta ln(\tau_{ict}) + \beta_x TFP_{fict} + \gamma_x \left(\Delta ln(\tau_{ict}) \times TFP_{fict} \right) + \varphi_X X + FE + \varepsilon_{ifct} \tag{3}$$

where x_{ifct} denotes export volume of product i exported by firm f to country c in the period t. We expect that the impact of increasing tariff be negative on export volume, and γ_x the coefficient on the interaction term should be positive, implying that the export volume elasticity to tariff rate changes should decrease with the firm's performance. The export volume elasticity to tariff changes should decrease with the firm's performance.

4. Data and Results
4.1 Data
This paper tests the role of productivity in tariff absorption using a database on Iranian manufacturing firms from different sources. The trade data are used to measure the export prices, which reports by Tehran Chamber of Commerce, Industries, Mines and Agriculture for each firm by destination and year. This database includes the quantity (in kilogram) and the value (in Dollar and Iranian Rial) of exporters for each eight-digit product. Unit values are computed by dividing the export value by export quantity as $P_{ifct} = {V_{ifct}}/{x_{ifct}}$, where V_{ifct} and x_{ifct} are the total value and quantity of product i at HS8 exported by firm f to country c in year t. We exclude transactions with missing values in quantity, destination, time and value. To compute the changes of the log prices, we also keep those product-firm-country-

year cells which survive in two continuous years.

In our data tariffs are identified at the country-product-year level, where a product is identified as an HS8 code and that are the same level of trade data. The tariff data are collected by the World Integrated Trade Solution (WITS) and reports the tariff rate that other countries impose on Iranian exports of different products.

We have estimated total factor productivity in different ways by its TFP or by labor productivity. TFP is constructed according to Foster, Haltiwanger, and Syverson (2008); Gervais (2015); Pierce (2011) as follows:

$$lnTFP_{pt} = lnQ_{pt} - \phi_K lnK_{pt} - \phi_L lnL_{pt} - \phi_E lnE_{pt} - \phi_M lnM_{pt}$$
(4)

where TFP is the total factor productivity of plant p in period t, Q, K, L, E and M are output, capital, labor, energy and material inputs respectively. The factors are available in detail for each firm existing at the ISIC 4-digit from 2002 to 2007, but from 2008 to 2015 the available data are in aggregate in each 4-digit ISIC category. The data for this section are obtained from the Statistical Center of Iran.

As shown later for the robustness check, we also compute the labor productivity as the ratio of value added per worker as an alternative to TFP. But our results are unaffected by a modification of the TFP measure.

Table 1 contains descriptive statistics for these for the period of 2002-2015, including number of industries, products, exporting firms, and destination countries, and summary statistics for the main variables used in our empirical analysis. We report information on positive export flows of firms considering their main export product. Therefore the number of firms considered in our sample reduced to 1609, as we needed each firms at least export one product to the same destination in two continuous years and the number of destination country in our analysis is 48. Average changes in export prices and volume are reasonable as we dropped some outliers that make them noisy.

Table 1: Summary Statistics

	2002-2015		
Number of Firms	**1600**		
Number of countries	**48**		
Variables	**Number of Observation**	**Mean**	**Std.Dev.**
$\Delta ln P_{ifct}$	15120	0.0969	0.5792
$\Delta ln X_{ifct}$	15120	0.1262	1.6063
$\Delta \tau_{ict}$	15120	-0.0640	0.8958
TFP_{ifct}	15120	0.1239	0.1801
$\Delta ln EXR_{ct}$	15120	-0.0103	0.8636
$\Delta ln GDP_{ct}$	15120	0.0565	0.0660

Average growth rate of prices and volume is 9% and 12%, indicating export volume is more variable.

4.2 Firm Level Results

Table 2 reports the results of the estimations of export price and export volume. As computing unit values and export volumes at the firm level is problematic when the firm exports more than a single product to a given destination, therefore we restrict the sample by keeping the observations only for the main product exported by the firm to a specific destination in at least two consecutive years.

In column1, we regress the changes in export price on TFP with a product-country-year fixed effect. The estimated coefficient is positive and significant, implying that firms with high productivity set higher prices for their exports than firms with low productivity.

In column2, we obtain the coefficient for tariff pass through negative and significant (-0.080), meaning that there is firm level tariff absorption and on average firms absorb 8 percent of the increase in tariff by reducing their export prices. The impact of firm productivity on tariff absorption elasticity is represented in column 3, the estimated coefficient for $\Delta ln(\tau_{ict})$ is still negative and significant while the coefficient for the interaction component show that high productivity firms absorb less the increase in tariff and pass more the changes into export price. Considering -6.2 percent the tariff absorption elasticity for low productivity firms and the coefficient of interaction 0.31

percent, the absorption elasticity for higher productivity firm will obtain 5.89 percent. Here we use both product-year and country-year fixed effects to control for product-year and country-year specific shocks to changes of export prices.

In column4, bilateral real exchange rate and GDP are added as control variables. Since these two variables are country-year specific, we drop the country-year fixed effect and only keep the product-year fixed effect in the regression. The results show that the elasticity of export price relative to exchange rate is positive and significant, while the ratio for GDP is negative and insignificant, implying that the price of exporting products is lower in bigger countries or when market size is larger.

Table 2: Tariff Pass-through

Dependent Variable Regressors	lnP_{ifct}	ΔlnP_{ifct}	ΔlnP_{ifct}	ΔlnP_{ifct}
$TFPH_{ifct}$	0.115* (0.062)		0.023** (0.011)	0.119* (0.062)
$\Delta \ln(\tau_{ict})$		-0.080*** (0.023)	-0.062* (0.035)	-0.055 * (0.032)
$\Delta \ln(\tau_{ict}) \times TFPH_{ifct}$			0.003 *** (0.001)	0.0002*** (0.000)
$\Delta lnEXR_{ct}$				0.140** (0.067)
$\Delta lnGDP_{ct}$				-0.513 (0.669)
Fixed Effects	ict	$it + ct$	$it + ct$	it
R^2	0.21	0.12	0.12	0.14

Notes: Robust standard errors reported in parentheses; *, **, and *** denote 10%, 5%, and 1% significance levels.

Table 3 shows that export volumes react negatively to a tariff rate changes. We find that the elasticity of export volume to tariff tare is -5.8 percent, implying that if a foreign country increase its tariff by 1 percent, Iran will decrease its trade volume to that country on average by 5.8 percent. In column 2, we consider that the impact of productivity on the changes of trade volume, the result show the elasticity of exporter volume to a tariff rate changes decreases with performance as the interaction term between the tariff rate and TFP is positive. It shows that better performance firms decrease their export volume less than firms with weaker performance. If lower productivity firms decrease their export volume by 1.8 percent as a result of 1 percent increase in

tariff rate, the elasticity of export volume to tariff rate changes for higher productivity firms is -1.3 percent. We regress the equation once more with two additional variables, exchange rate and GDP, the findings indicate that exchange rate depreciation increases the volume of trade as our products become cheaper for foreign importers. The relationship between log change of GDP and export volume is obtained positive but insignificant.

Table 3: Tariff Pass-through and Export Volume

Dependent Variable Regressors	Δlnx_{ifct}	Δlnx_{ifct}	Δlnx_{ifct}
$\Delta \ln(\tau_{ict})$	-0.058* (0.033)	-0.018** (0.008)	-0.022* (0.012)
$\Delta \ln(\tau_{ict}) \times TFPH_{ifct}$		0.005*** (0.001)	0.005*** (0.001)
$\Delta lnEXR_{ct}$			0.177* (0.095)
$\Delta lnGDP_{ct}$			0.974 (2.369)
Fixed Effects	ict	$it + ct$	it
R^2	0.16	0.17	0.17

Note: Robust standard errors reported in parentheses; *, **, and *** denote 10%, 5%, and 1% significance levels.

We now proceed to check our results are robust to alternative measure of performance (value added per worker instead of TFP). In tables 4 and 5 we replicate our regression from table 2 and 3 using value added per worker as an alternative performance indicator. The results on prices and volumes are strengthened both qualitatively and quantitatively: the interaction terms are, for instance, significant in all specifications for export volumes.

Table 4: Tariff Pass-through in Terms of Labor Productivity

Dependent Variable Regressors	ΔlnP_{ifct}	ΔlnP_{ifct}	ΔlnP_{ifct}	ΔlnP_{ifct}
$\Delta lnLP_{ifct}$	0.350** (0.147)		0.052** (0.026)	0.429*** (0.153)
$\Delta \ln(\tau_{ict})$		-0.080 *** (0.023)	-0.010* (0.006)	-0.096* (0.056)
$\Delta \ln(\tau_{ict}) \times \Delta lnLP_{ifct}$			0.006** (0.003)	0.005** (0.002)
$\Delta lnEXR_{ct}$				0.198* (0.115)
$\Delta lnGDP_{ct}$				-1.284 (0.965)
Fixed Effects	ict	$it + ct$	$it + ct$	it
R^2	0.18	0.12	0.17	0.17

Note: Robust standard errors reported in parentheses; *, **, and *** denote 10%, 5%, and 1% significance levels.

Table 5: Tariff Pass-through and Export Volume in Terms of Labor Productivity

Dependent Variable Regressors	lnx_{ifct}	Δlnx_{ifct}	Δlnx_{ifct}
$\Delta \ln(\tau_{ict})$	-0.058* (0.033)	-0.029** (0.014)	-0.030** (0.014)
$\Delta \ln(\tau_{ict}) \times \Delta lnLP_{ifct}$		0.061** (0.030)	0.059** (0.030)
$\Delta lnEXR_{ct}$			0.530* (0.312)
$\Delta lnGDP_{ct}$			5.248 (3.318)
Fixed Effects	ict	$it + ct$	it
R^2	0.16	0.17	0.17

Note: Robust standard errors reported in parentheses; *, **, and *** denote 10%, 5%, and 1% significance levels.

In sum, the regression results presented in tables 4 and 5 imply that no matter which estimation of firm productivity considered, there is strong support for our prediction of the incomplete tariff pass-through and the inverse relationship between firms' tariff absorption elasticity and its productivity. The coefficients for bilateral exchange rate and GDP give us the same interpretation as before, exchange rate depreciation increase the export prices as exporters cost increase and give exporters the opportunity to export more as their price for products is cheaper for foreign importers. The GDP result support the fact that prices are higher in bigger market size like the demand for import.

5. Conclusion
This paper examined the incompleteness of tariff pass-through for Iranian exporters' firms and the dependence of tariff pass through on firm heterogeneity in productivity. To our knowledge this article is the first to document this fact for Iranian exporters' firms. Using the Iranian transaction level export data and firm level data for the period of 2002-2015, we find that firm level tariff pass-through for Iranian exporters are incomplete. Furthermore, high performance firms prefer to absorb tariff change in their markups less than the low performance firms. Examination done for export volume as well and the findings reveal that firms decrease their export's quantity as the foreign country impose higher tariff on their products.

These results have welfare implications for trade liberalization. If tariffs are lowered under the justification of increased household welfare through lower prices, then the potential unintended consequence of static consumer prices through incomplete pass-through is an important factor to consider.

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