AN INDUSTRY-SPECIFIC MODEL WITH NEW ENTRY OF SUBJECT IMPORTS

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Abstract

We develop an industry-specific, partial equilibrium modeling framework for estimating the effects of changes in tariffs on imports and domestic producers in cases where there are no initial volumes of imports from suppliers subject to the tariff changes. We use a reference group to calibrate the marginal costs of subject imports entering the market. We use the model in a series of simulations to estimate the effects of reducing tariffs on subject imports. Additionally, we show that the calibrated marginal cost of subject imports is sensitive to the initial levels of imports in the reference group.

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1 Introduction

Partial equilibrium (PE) models of international trade are often used to simulate the effects of changes in trade policy on imports and domestic shipments in a specific industry and national market. Generally, the increase in imports and the reduction in domestic shipments following a tariff reduction is larger if the initial volume of imports subject to the tariff is large relative to the size of the market, and if the reduction in the tariff rate on these imports is large. Hallren and Riker (2017) is an example of a standard Armington Constant Elasticity of Substitution (CES) PE model of tariff changes.

The main advantage of the standard Armington CES PE model is its modest data requirements: initial market shares, initial and revised tariff rates, and a set of elasticity values. One of the main limitations of this standard model is that it is not equipped to estimate the effects of changes in trade policy when there are no initial imports from suppliers subject to the tariff reduction, for example because the initial tariff that they face is high. In this case, there are no data on how subject imports will perform against competitors after a tariff reduction. These imports have no track record in the market.

This is an important limitation of standard Armington CES PE models, because it is not unusual to record zero trade flows between pairs of countries in particular products, especially when there are tariffs and other barriers to trade. There is an extensive trade literature devoted to this issue. The prevailing view – developed in Melitz (2003), Das, Roberts and Tybout (2007), Helpman, Melitz and Rubinstein (2008), and the related literature on trade with firm heterogeneity – is that zero trade flows can be explained by fixed costs of exporting: each firm needs to achieve a certain scale of exports before it can profitably export to a foreign market. The firm might decide not to enter the foreign market while the tariff rate that it faces is high but might decide to enter after the tariff rate is eliminated or significantly reduced. This theoretical explanation for zero trade flows provides a framework

for understanding why there may be zero trade flows, but it does not easily translate into an empirical model for predicting entry into the market or post-entry import volumes, because fixed costs of exporting are usually not directly observed (especially when no exporting has occurred yet). In addition, entry decisions can be complex: they often involve sunk, irreversible costs and depend in a complicated way on a firm's expectations over a long and uncertain time horizon.

Still, the problem is manageable if the aim of the model is to predict the increase in the volume of subject imports conditional on entry, rather than the unconditional increase. If there is no entry, there will be no increase in subject imports, and this provides a lower bound. Conditional on entry, there will be an increase in subject imports, and this post-entry volume provides an upper bound on the increase in subject imports.

Even accepting the conditional prediction as an upper bound, there is still a lack of data, since suppliers subject to the tariff reduction have not yet participated in the market. Typically the entrants' costs of supplying the market are not directly observable, but this information is needed to predict how well the new entrant will compete in its new market if it enters. One approach is to find a reference group of imports that are already competing in the market and are comparable to the subject imports in terms of their cost of supplying the market (other than the initial tariff rates that they face) and then impute the marginal cost of the reference group to the subject imports.

The choice of an appropriate reference group of imports will depend on the specific industry and market to which the model is applied, but the general goal is to find imports that are currently in the market and are likely to have marginal costs (other than tariff rates) that are similar to the marginal costs of supplying subject imports to the market after the tariff reduction. For example, when similar firms from the same country face different tariff rates (sometimes the case for anti-dumping and countervailing duties), firms from the country that are initially exporting the product to the market and are not subject to the

tariff reduction might be an appropriate reference group for calibrating the cost of supplying subject imports to the market. In other cases, the reference group might include imports from other countries at a comparable level of economic development, or imports from the same country of similar, but not identical, product categories that face different initial tariff rates. But, again, the appropriate reference group will vary case by case.

In this paper, we derive a PE model of tariff changes that implements this imputation approach. We report a series of simulations that illustrate the sensitivity of estimated effects to model inputs. The rest of the paper is organized in three parts. Section 2 presents the model. Section 3 reports model simulations. Section 4 concludes.

2 Modeling Framework

The model assumes that there are four types of firms in the industry that can supply a specific national market: domestic (d), subject imports (s), a reference group of imports not subject to the tariff reduction (r), and other non-subject imports (n). Initially, there are no subject imports due to a prohibitively high tariff rate and fixed costs of exporting. The initial tariff rates on imports are t_{r0} and t_{n0}, and there are no tariffs on domestic shipments.

Consumers have CES demands with elasticity of substitution σ among the four groups of products. Equation (1) is consumer expenditure on the products of firm $j \in \{d, r, n\}$.

$$V_j = E \frac{(p_j\ (1+t_j))^{1-\sigma}}{\sum_k (p_k\ (1+t_k))^{1-\sigma}} \tag{1}$$

E is total expenditure on the products of the industry in the market, p_j is the pre-tariff producer price of firm j, and t_j is the tariff rate on imports of firm j. The variable k indexes all of the firms that supply the market. The model assumes that consumers have Cobb-Douglas preferences over composites of the products in different industries, and this implies that the expenditures on the specific industry in the model are a constant share of aggregate

expenditures in the market.[1]. Aggregate expenditures are exogenous to our PE framework.

We assume that the production of firm j involves constant marginal costs c_j and fixed costs f_j.[2] Once the firms have entered the market, they face no capacity constraints when expanding their shipments to the market.[3] Fixed costs of exporting to the market explain why there are no subject imports under the initial tariff rate. The fixed costs do not affect the firm's marginal cost pricing.

We assume that there is Bertrand price competition in the differentiated products. The set of competing suppliers is also treated as exogenous in the model; it is fixed except for the new entry of subject imports. Equation (2) is the profits of firm j.[4]

$$\pi_j = E \frac{(p_j\ (1+t_j))^{-\sigma}}{\sum_k (p_k\ (1+t_k))^{1-\sigma}}\ (p_j - c_j) - f_j \tag{2}$$

Equation (3) is the first-order condition for profit maximization by firm j, taking as given the prices of its competitors in the market (the standard Bertrand oligopoly pricing assumption).

$$q_j + (p_j - c_j)\left(\frac{q_j}{p_j}\right)(-\sigma - (1-\sigma)\ m_j)\ =\ 0 \tag{3}$$

q_j is the quantity supplied by firm j, and m_j is the firm's market share.

Equation (4) uses the first-order conditions (3), along with data on prices and market shares in the initial equilibrium, to calibrate the marginal costs of each firm that is initially supplying the market.

[1]This is a standard assumption in the CGE literature, including Hosoe, Gasawa and Hashimoto (2015)

[2]For the domestic firm, f_d only includes fixed costs of production. For foreign firms, it also includes the fixed costs of exporting.

[3]Though there are no capacity constraints on suppliers, expansion of their sales is still limited by downward sloping demand curves. The assumption of no capacity constraints likely leads to an overstatement of the conditional prediction for the expansion of subject imports, and this is another sense in which the model establishes an upper bound.

[4]The consumer price of product j is $p_j(1+t_j)$, and the producer price is p_j.

$$c_j = p_j \left(1 + \frac{1}{(\sigma - 1)\, m_j - \sigma}\right) \tag{4}$$

We impute the marginal cost of the reference group of imports to the subject imports. To be clear, the model is not imputing the initial market share of the reference group to subject imports after the tariff reduction; it is using the initial market share of the reference group of imports and the initial tariff they face to calibrate the marginal cost of the reference group, which is an exogenous variable in the model. The imputation assigns this value as the marginal cost of subject imports:

$$c_s = c_r \tag{5}$$

Equation (6) is the first-order condition of firm j, re-written in terms of the prices of all of the suppliers in the market.

$$p_j + (p_j - c_j) \left((\sigma - 1) \frac{(p_j\ (1 + t_j))^{1-\sigma}}{\sum_k (p_k\ (1 + t_k))^{1-\sigma}} - \sigma\right) = 0 \tag{6}$$

The first-order conditions for all of the firms jointly determine equilibrium prices after the tariff reduction. The system of price equations based on (6) define the new equilibrium prices of the initial competitors and the new entrant, given the elasticity of substitution, calibrated or imputed marginal costs, and revised tariff rates. The first-order conditions characterize the new equilibrium conditional on the entry of subject imports (the conditional prediction); if there were no entry, then the value of subject imports would still be equal to zero and there would be no change from the initial market equilibrium. Given new equilibrium prices, the model calculates the new value of imports and domestic shipments, conditional on the entry of subject imports, using (1) with $j \in \{d, s, r, n\}$.

The unconditional prediction for the value of subject imports is equal to the probability of entry after the tariff reduction times the conditional prediction.

Equation (7) is the unconditional prediction, assuming that the subject imports will only enter if it is profitable after the tariff reduction.

$$V_s = \phi_s \; E \; \frac{(p_s \; (1 + t_s))^{1-\sigma}}{\sum_k (p_k \; (1 + t_k))^{1-\sigma}} \tag{7}$$

where ϕ_s equals one if $\pi_s \geq 0$ after the tariff reduction and zero otherwise. Assigning a value to ϕ_s requires assessing profitability using (2) and data on the fixed cost of producing and exporting subject imports to the market, f_s, if available.

3 Illustrative Simulations

Table 1 reports simulated increases in subject imports and reductions in domestic shipments for a hypothetical industry with an initial import penetration rate of 50%, no initial subject imports, and no initial tariffs on non-subject imports.

The tariff on subject imports is reduced in these simulations – from an unspecified but prohibitively high rate to zero. The table reports three simulations that vary in their assumption about the initial market share of imports in the reference group, ranging from 10% to 90%. When the initial share of reference group imports is higher, this results in lower calibrated costs for these comparable imports, and these lower costs are imputed to the subject imports. An increase in this initial market share magnifies the simulated increase in the value of subject imports and the simulated reduction in the value of domestic shipments.

Table 2 reports three additional simulations with different assumptions about the tariff rate on subject imports after the tariff reduction, ranging from 0% to 20%. A reduction in the revised tariff rate (greater liberalization) magnifies the simulated increase in the value of subject imports and the simulated reduction in the value of domestic shipments.

Even though subject imports are initially zero, imports can expand significantly. It depends on their imputed costs (illustrated in Table 1) and on the revised tariff rate that

they face (illustrated in Table 2). In contrast, the initial tariff rate on subject imports does not enter the model directly.

4 Conclusions

The model described in this paper can be used to estimate the economic effects of reductions in tariffs in cases where there are no initial imports from suppliers subject to the tariff reductions. The modeling can be extended to explicitly model entry decisions, with additional data, but if the goal is to establish an upper bound on the economic effects of the tariff reduction, then the practical model that conditions on entry fits the bill.

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Table 1: Simulations for Different Share of the Reference Group of Imports

Model Inputs			
Elasticity of Substitution	4	4	4
Initial Value of Domestic Shipments (V_{d0})	50.0	50.0	50.0
Initial Value of Reference Group of Imports (V_{r0})	5.0	25.0	45.0
Initial Value of Other Non-Subject Imports (V_{n0})	45.0	25.0	5.0
Initial Tariff Rate on Reference Group Imports (t_{r0})	0.0	0.0	0.0
Initial Tariff Rate on Other Non-Subject Imports (t_{n0})	0.0	0.0	0.0
Reduced Tariff Rate on Subject Imports (t_s)	0.0	0.0	0.0
New Equilibrium			
New Value of Domestic Shipments (V_d)	31.6	31.4	29.0
New Value of Subject Imports (V_s)	19.6	22.9	26.7
New Value of Reference Group of Imports (V_r)	19.6	22.9	26.7
New Value of Other Non-Subject Imports (V_n)	29.2	22.9	17.6
Impact			
Change in the Value of Domestic Shipments	-18.4	-18.6	-21.0
Change in the Value of Subject Imports	19.6	22.9	26.7
Change in the Value of Reference Group of Imports	14.6	-2.1	-18.3
Change in the Value of Other Non-Subject Imports	-15.8	-2.1	12.6

Table 2: Simulations for Different Revised Tariff Rates on Subject Imports

Model Inputs			
Elasticity of Substitution	4	4	4
Initial Value of Domestic Shipments (V_{d0})	50.00	50.00	50.00
Initial Value of Reference Group of Imports (V_{r0})	25.00	25.00	25.00
Initial Value of Other Non-Subject Imports (V_{n0})	25.00	25.00	25.00
Initial Tariff Rate on Reference Group of Imports (t_{r0})	0.0	0.0	0.0
Initial Tariff Rate on Other Non-Subject Imports (t_{n0})	0.0	0.0	0.0
Reduced Tariff Rate on Subject Imports (t_s)	0.0	0.1	0.2
New Equilibrium			
New Value of Domestic Shipments (V_d)	31.4	32.8	34.0
New Value of Subject Imports (V_s)	22.9	19.1	16.0
New Value of Reference Group of Imports (V_r)	22.9	24.0	25.0
New Value of Other Non-Subject Imports (V_n)	22.9	24.0	25.0
Impact			
Change in the Value of Domestic Shipments	-18.6	-17.2	-16.0
Change in the Value of Subject Imports	22.9	19.1	16.0
Change in the Value of Reference Group of Imports	-2.1	-1.0	0.0
Change in the Value of Other Non-Subject Imports	-2.1	-1.0	0.0