IMPORT ENTRY FOLLOWING A TARIFF REDUCTION: ESTIMATING AN UPPER BOUND

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Abstract

It is difficult to predict the magnitude of new import entry following a tariff reduction. New import entry is generally more likely the larger the tariff reduction and the smaller the minimum scale of foreign firms already in the market, but a precise prediction could require an impractical amount of information about the costs facing potential new entrants. To address this problem, we develop a practical, model-based methodology for estimating the *upper bound* on the quantity of imports from a new entrant after a reduction in the tariff on a specific product from a specific source country, using limited data from the market equilibrium prior to the tariff reduction.

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1 Introduction

When policymakers are considering reducing or even eliminating a tariff on a specific category of imports, they try to predict the economic consequences of the policy change. The effects of a tariff reduction on consumers, domestic producers, and trade flows will depend in part on whether new foreign firms enter the market after the tariff reduction. Predicting new entry is difficult, since potential new entrants from other countries do not have a track record of competing in the import market. It is possible that there will be a surge of new imports when the tariff is reduced; even so, there will be an *upper bound* on the quantity of new imports after the reduction. The fact that there were no imports from a specific foreign source with the tariff in place suggests a limit on the cost competitiveness of the potential entrant: if the foreign source were very cost competitive it would supply the market through imports even with the tariff in place. We formalize this idea using an industry-specific calibrated simulation model of international trade.

Trade economists have developed theoretical explanations for why we see zero import flows between pairs of countries in specific products. The prevailing view is that zero trade flows reflect fixed costs of exporting to a foreign market. Helpman, Melitz and Rubinstein (2008) offers theoretical and econometric support for this fixed cost explanation. In their model, a firm only enters a foreign market if its variable profits from supplying the market each period exceed its recurring fixed costs of participating in the market. Within this modeling framework, new import entry after a tariff reduction is more likely the larger the tariff reduction and the smaller the minimum scale of foreign firms that already supply the market. However, converting this general insight into a precise prediction about the quantity of new imports could require an impractical amount of information about the costs facing potential new entrants.

To address this problem, we develop a practical, model-based methodology for estimating

the *upper bound* on the quantity of imports from new entrants following a tariff reduction on a specific product from a specific source country. The methodology only requires data available from the market equilibrium prior to the tariff reduction. It extends the approach to modeling new import entry in Riker (2019) and Riker and Schreiber (2019).

The rest of this paper is organized into four parts. Section 2 introduces the industry-specific model. Section 3 reports a series of illustrative simulations. Section 4 concludes.

2 Structural Model

The model of trade is characterized by assumptions about demand, costs, and market structure. Consumer demand has a constant elasticity of substitution (CES) between firms within the same industry, and total industry expenditures are a constant share of aggregate expenditures.[1]

$$q_j = \alpha \; P^{\;\sigma-1} \; (p_j \; (1+t_j))^{-\sigma} \; \beta_j \tag{1}$$

q_j is the quantity demanded from firm j, p_j is the firm's price, P is the industry price index, and t_j is the tariff rate that applies if firm j supplies the market by importing. α and β_j are general and source-specific demand parameters, and σ is the elasticity of substitution. Equation (2) is the CES price index for the industry.

$$P = \left(\sum_j \beta_j \; (p_j \; (1+t_j))^{1-\sigma} \right)^{\frac{1}{1-\sigma}} \tag{2}$$

All foreign firms in the industry face a fixed cost of serving the market equal to x. Firm j has a constant marginal cost equal to mc_j. Equation (3) is the profits of firm j from selling q_j in the market.

[1]The model treats aggregate expenditures as exogenous.

$$\pi_j = (p_j \ - \ mc_j) \ q_j - x \tag{3}$$

In the initial market equilibrium, there is one domestic firm (d) and one foreign firm (f).[2] There is one potential entrant (e) that does not enter the market at initial tariff rate t_{e0}. We model competition in the market as a two-stage game, with the potential entrant e deciding whether to enter in the first stage, and then all market participants simultaneously choosing their prices as Bertrand oligopolists in the second stage. We normalize $\beta_d = 1$ without loss of generality and assume that $\beta_f = \beta_e = \beta$.

The first step in the simulation is to calibrate the demand parameters using expenditure values from the initial equilibrium (v_{d0} and v_{f0}).[3] We normalize initial prices to one, so initial quantities are $q_{do} = v_{d0}$ and $q_{do} = \frac{v_{f0}}{1+t_{f0}}$. Equations (4) and (5) calibrate β and α based on data from the initial equilibrium.

$$\beta = \frac{v_{f0}}{v_{d0}} \ \left(\frac{p_{f0} \ (1 + t_{f0})}{p_{d0}} \right)^{\sigma - 1} \tag{4}$$

$$\alpha = q_{d0} \ \left((p_{d0})^{1-\sigma} + \beta \ (p_{f0} \ (1 + t_{f0}))^{1-\sigma} \right) \ (p_{d0})^{\sigma} \tag{5}$$

The second step is to calibrate the marginal costs of the two incumbent firms, again using data from the initial equilibrium. Equations (6) and (7) are the first order conditions for the profit-maximizing prices of firms d and f.

$$mc_d = p_{d0} \ \left(1 \ - \ \frac{1}{\sigma - (\sigma - 1) \ s_{d0}} \right) \tag{6}$$

[2]The model can easily be extended to include additional incumbent suppliers. If there are multiple foreign suppliers indexed by f, then x is the minimum value of $((p_{f0} - mc_f) \ q_{f0})$ across all f.

[3]The zero subscript indicates initial equilibrium values.

$$mc_f = p_{f0} \left(1 - \frac{1}{\sigma - (\sigma - 1)\ s_{f0}}\right) \tag{7}$$

The initial market shares s_{d0} and s_{f0} are defined in (8) and (9).

$$s_{d0} = \frac{(p_{d0})^{1-\sigma}}{(p_{d0})^{1-\sigma} + \beta\ (p_{f0}\ (1 + t_{f0}))^{1-\sigma}} \tag{8}$$

$$s_{f0} = \frac{\beta\ (p_{f0}\ (1 + t_{f0}))^{1-\sigma}}{(p_{d0})^{1-\sigma} + \beta\ (p_{f0}\ (1 + t_{f0}))^{1-\sigma}} \tag{9}$$

The third step is to calibrate the incumbent foreign firm's fixed cost of supplying the market. We know that the incumbent's variable profits at least cover its fixed cost in the initial equilibrium, since it is (weakly) profitable for the firm to supply the market. It follows that the incumbent's fixed cost x is less than or equal to the value $\overline{x}$ defined in (10).

$$\overline{x} = (p_{f0} - mc_f)\ q_{f0} \tag{10}$$

We assume that the fixed cost of supplying the market is the same for all foreign firms (the incumbent foreign firm as well as the new entrant), though there may be differences in the two foreign suppliers' marginal costs of production due to heterogeneity in the firms' productivity, as in Helpman et al. (2008), and the two foreign suppliers may face different tariff rates.

The fourth step in the simulation is to calculate the minimum marginal cost of potential entrant e that is consistent with the fact that e did not enter the market when it faced initial tariff t_{e0} and fixed cost $x \leq \overline{x}$. Equations (11) through (17) implicitly define the profit-maximizing prices and market shares if firm e were to deviate from the initial no-entry equilibrium and enter the import market in the first stage when it still faces tariff t_{e0} and

the three firms then set Bertrand oligopoly prices in the second stage.[4]

$$s_{e1} = \frac{\beta \ (p_{e1} \ (1 + t_{e0}))^{1-\sigma}}{(p_{d1})^{1-\sigma} + \beta \ (p_{f1} \ (1 + t_{f0}))^{1-\sigma} + \beta \ (p_{e1} \ (1 + t_{e0}))^{1-\sigma}} \tag{11}$$

$$s_{d1} = \frac{(p_{d1})^{1-\sigma}}{(p_{d1})^{1-\sigma} + \beta \ (p_{f1} \ (1 + t_{f0}))^{1-\sigma} + \beta \ (p_{e1} \ (1 + t_{e0}))^{1-\sigma}} \tag{12}$$

$$s_{f1} = \frac{\beta \ (p_{f1} \ (1 + t_{f0}))^{1-\sigma}}{(p_{d1})^{1-\sigma} + \beta \ (p_{f1} \ (1 + t_{f0}))^{1-\sigma} + \beta \ (p_{e1} \ (1 + t_{e0}))^{1-\sigma}} \tag{13}$$

$$P_1 = \left((p_{d1})^{1-\sigma} + \beta \ (p_{f1} \ (1 + t_{f0}))^{1-\sigma} + \beta \ (p_{e1} \ (1 + t_{e1}))^{1-\sigma}\right)^{\frac{1}{1-\sigma}} \tag{14}$$

$$mc_e = p_{e1} \ \left(1 \ - \ \frac{1}{\sigma - (\sigma - 1) \ s_{e1}}\right) \tag{15}$$

$$mc_d = p_{d1} \ \left(1 \ - \ \frac{1}{\sigma - (\sigma - 1) \ s_{d1}}\right) \tag{16}$$

$$mc_f = p_{f1} \ \left(1 \ - \ \frac{1}{\sigma - (\sigma - 1) \ s_{f1}}\right) \tag{17}$$

Equation (18) is the break-even condition for the new entrant. When combined with (11) through (17), (18) implicitly defines a lower bound on the marginal cost of the new entrant, $\underline{mc_e}$, in terms of the maximum value of the fixed cost $\overline{x}$.

$$(p_{e1} - \underline{mc_e}) \ \alpha \ P_1 \ ^{\sigma-1} \ (p_{e1} \ (1 + t_{e0}))^{-\sigma} \ \beta = \overline{x} \tag{18}$$

Firm e did not enter and supply the market in the initial equilibrium with tariff rate t_{e0}, so

[4]The subscript 1 indicates this hypothetical deviation from the initial equilibrium.

its marginal cost mc_e must be greater than $\underline{mc_e}$.

This last calculation assumes that firm e has the *ability* to supply the product to international markets. The model does not evaluate whether it is *feasible* for the new firm to enter. There may be prohibitive supply constraints unrelated to the tariff. This could be analyzed by collecting background information on whether the potential entrant has unused production capacity that can be exported or already sends exports to third countries that could be diverted to the country reducing its tariff.

The final step in the simulation is to calculate the upper bound on the quantity of imports from the new entrant after the tariff is reduced to $t_e < t_{e0}$. Equations (19) through (25) jointly determine the prices of the firms, the industry price index, and market shares in the new equilibrium with new entry after the tariff reduction.[5]

$$s_{e2} = \frac{\beta \ (p_{e2} \ (1 + t_e))^{1-\sigma}}{(p_{d2})^{1-\sigma} + \beta \ (p_{f2} \ (1 + t_f))^{1-\sigma} + \beta \ (p_{e2} \ (1 + t_e))^{1-\sigma}} \tag{19}$$

$$s_{d2} = \frac{((p_{d2})^{1-\sigma}}{(p_{d2})^{1-\sigma} + \beta \ (p_{f2} \ (1 + t_f))^{1-\sigma} + \beta \ (p_{e2} \ (1 + t_e))^{1-\sigma}} \tag{20}$$

$$s_{f2} = \frac{\beta \ (p_{f2} \ (1 + t_f))^{1-\sigma}}{(p_{d2})^{1-\sigma} + \beta \ (p_{f2} \ (1 + t_f))^{1-\sigma} + \beta \ (p_{e2} \ (1 + t_e))^{1-\sigma}} \tag{21}$$

$$P_2 = \left((p_{d2})^{1-\sigma} + \beta \ (p_{f2} \ (1 + t_f))^{1-\sigma} + \beta \ (p_{e2} \ (1 + t_e))^{1-\sigma}\right)^{\frac{1}{1-\sigma}} \tag{22}$$

$$\underline{mc_e} = p_{e2} \ \left(1 \ - \ \frac{1}{\sigma - (\sigma - 1) \ s_{e2}}\right) \tag{23}$$

[5]The subscript 2 indicates the new equilibrium after the tariff reduction.

$$mc_d = p_{d2} \left(1 - \frac{1}{\sigma - (\sigma - 1)\ s_{d2}}\right) \tag{24}$$

$$mc_f = p_{f2} \left(1 - \frac{1}{\sigma - (\sigma - 1)\ s_{f2}}\right) \tag{25}$$

Equation (26) is the upper bound on the quantity of imports from the new entrant in this equilibrium, based on the values of the model parameters calibrated from the initial equilibrium and the lower bound on marginal cost $\underline{mc_e}$.

$$q_{e2} = \alpha\ P_2{}^{\sigma-1}\ (p_{e2}\ (1 + t_e))^{-\sigma}\ \beta \tag{26}$$

Equation (27) is the change in the profits of the domestic firm, as it moves from the initial equilibrium to this upper bound outcome.

$$\Delta\pi_d = (p_{d2} - mc_d)\ q_{d2} - (p_{d0} - mc_d)\ q_{d0} \tag{27}$$

Finally, (28) is the change in the employment of the domestic firm, as it moves from the initial equilibrium to this upper bound outcome, assuming a constant unit labor requirement μ.

$$\Delta L_d = \mu\ (q_{d2} - q_{d0}) \tag{28}$$

3 Illustrative Simulations

Next, we report a series of simulations that illustrate the sensitivity of the estimated economic effects to the inputs of the model. The top panel of Table 1 lists the inputs of the model. The middle panel lists parameters that are calibrated within the model. The bottom panel reports a set of simulated economic effects.

For the set of model inputs considered, the tariff reduction leads to the entry of imports from firm e and a reduction in the prices and quantity of sales of the domestic firm and the incumbent foreign supplier. The first column of estimates in Table 1 is a base model, and the next two columns report estimates from alternative simulations that vary the initial tariff rate t_{e0}. The initial rate is reduced to zero in all three simulations. A higher initial tariff rate implies a larger tariff reduction, a smaller calibrated lower bound on the marginal cost of the new entrant ($\underline{mc_e}$), but the same calibrated value for the upper bound of the fixed cost of each foreign supplier ($\overline{x}$). The higher the initial tariff rate, the more cost competitive the entrant can be and still not enter in the initial equilibrium. The lower calibrated $\underline{mc_e}$ results in a larger upper bound on the quantity of import upon entry, and this magnifies the percent declines in the prices and quantities of firms f and d.

Table 1: Simulation Results under a Different Initial Tariff Rate

	Base Model	Alternative 1	Alternative 2
Model Inputs:			
Elasticity of substitution σ	4	4	4
Initial tariff rate facing prospective entrant e	5%	2%	10%
Revised tariff rate facing prospective entrant e	0%	0%	0%
Initial tariff rate for incumbent f	5%	5%	5%
Revised tariff rate for incumbent f	5%	5%	5%
Initial expenditures on domestic product v_{d0}	70	70	70
Initial expenditures on imports v_{f0}	30	30	30
Domestic unit labor requirement μ	1	1	1
Calibrated Parameters:			
Demand parameter α	100	100	100
Demand parameter β	0.50	0.50	0.50
Marginal cost mc_d	0.47	0.47	0.47
Marginal cost mc_f	0.68	0.68	0.68
Fixed cost of importing x	9.22	9.22	9.22
Minimum marginal cost $\underline{mc_e}$	0.51	0.54	0.48
Economic Effects:			
Quantity of imports from new entrant q_e	41.86	38.02	48.59
% Change in price of domestic firm p_d	-18.76%	-17.91%	-20.11%
% Change in quantity of domestic firm q_d	-6.13%	-5.11%	-8.00%
% Change in consumer price of incumbent importer p_f	-5.80%	-5.58%	-6.13%
% Change in quantity of incumbent importer q_f	-48.09%	-45.78%	-51.74%
Change in expenditure on domestic firm v_d	-16.62	-15.47	-18.55
Change in expenditure on incumbent importer v_f	-15.33	-14.64	-16.41
Change in expenditure on new entrant v_e	31.95	30.11	34.96
Change in the profits of the domestic firm π_d	-14.59	-13.78	-15.90
Change in the employment of the domestic firm L_d	-4.29	-3.58	-5.60

Table 2 repeats the base model, with firm e facing a 5% initial tariff rate, and then varies the value of the elasticity of substitution σ in alternative simulations 3 and 4. A higher elasticity of substitution implies a lower calibrated $\overline{x}$ and a higher calibrated $\underline{mc_e}$. With a larger σ, the initial equilibrium is less profitable and the break-even fixed cost is lower, so there is a less competitive, higher $\underline{mc_e}$ that would still cover the new entrant's fixed cost. This results in a smaller upper bound on the quantity of imports from new entrant e, smaller percent reductions in the prices of firms d and f, and larger percent reductions in their sales quantities.

Table 2: Simulation Results under a Different Elasticity of Substitution

	Base Model	Alternative 3	Alternative 4
Model Inputs:			
Elasticity of substitution σ	4	3	6
Initial tariff rate facing prospective entrant e	5%	5%	5%
Revised tariff rate facing prospective entrant e	0%	0%	0%
Initial tariff rate for incumbent f	5%	5%	5%
Revised tariff rate for incumbent f	5%	5%	5%
Initial expenditures on domestic product v_{d0}	70	70	70
Initial expenditures on imports v_{f0}	30	30	30
Domestic unit labor requirement μ	1	1	1
Calibrated Parameters:			
Demand parameter α	100	100	100
Demand parameter β	0.50	0.47	0.55
Marginal cost mc_d	0.47	0.38	0.60
Marginal cost mc_f	0.68	0.58	0.78
Fixed cost of importing x	9.22	11.90	6.35
Minimum marginal cost $\underline{mc_e}$	0.51	0.40	0.65
Economic Effects:			
Quantity of imports from new entrant q_e	41.86	45.46	39.41
% Change in price of domestic firm p_d	-18.76%	-22.68%	-14.13%
% Change in quantity of domestic firm q_d	-6.13%	-2.23%	-10.81%
% Change in consumer price of incumbent importer p_f	-5.80%	-7.07%	-4.27%
% Change in quantity of incumbent importer q_f	-48.09%	-43.68%	-53.54%
Change in expenditure on domestic firm v_d	-16.62	-17.08	-16.39
Change in expenditure on incumbent importer v_f	-15.33	-14.30	-16.66
Change in expenditure on new entrant v_e	31.95	31.38	33.04
Change in the profits of the domestic firm π_d	-14.59	-16.50	-11.85
Change in the employment of the domestic firm L_d	-4.29	-1.56	-7.56

Finally, Table 3 reports the base model again and then varies the initial import penetration rate, $\frac{v_{f0}}{v_{d0}+v_{f0}}$, in alternative simulations 5 and 6. A lower initial import penetration rate implies a lower calibrated $\overline{x}$ and a higher calibrated $\underline{mc_e}$. The smaller share of the incumbent foreign firm implies that fixed costs are relatively low, and so the new entrant's marginal costs must be high if the firm does not cover the fixed cost in the initial equilibrium. This results in a smaller upper bound on the quantity of imports from the new entrant, a larger percent price decline for firms d and f, and a smaller percent decline in their sales quantities. For a small enough initial import penetration rate (e.g., only 10% in alternative simulation 5), the sales quantity of the domestic firm *rises* with the tariff reduction due to the strength of the pro-competitive effects of the new entrant.

Table 3: Simulation Results under a Different Initial Import Share

	Base Model	Alternative 5	Alternative 6
Model Inputs:			
Elasticity of substitution σ	4	4	4
Initial tariff rate facing prospective entrant e	5%	5%	5%
Revised tariff rate facing prospective entrant e	0%	0%	0%
Initial tariff rate for incumbent f	5%	5%	5%
Revised tariff rate for incumbent f	5%	5%	5%
Initial expenditures on domestic product v_{d0}	70	90	50
Initial expenditures on imports v_{f0}	30	10	50
Domestic unit labor requirement μ	1	1	1
Calibrated Parameters:			
Demand parameter α	100	100	100
Demand parameter β	0.50	0.13	1.16
Marginal cost mc_d	0.47	0.23	0.60
Marginal cost mc_f	0.68	0.73	0.60
Fixed cost of importing x	9.22	2.57	19.05
Minimum marginal cost $\underline{mc_e}$	0.51	0.55	0.41
Economic Effects:			
Quantity of imports from new entrant q_e	41.86	14.27	74.41
% Change in price of domestic firm p_d	-18.76%	-25.25%	-13.70%
% Change in quantity of domestic firm q_d	-6.13%	**26.51%**	-44.46%
% Change in consumer price of incumbent importer p_f	-5.80%	-1.65%	-13.70%
% Change in quantity of incumbent importer q_f	-48.09%	-57.78%	-44.46%
Change in expenditure on domestic firm v_d	-16.62	-4.89	-26.03
Change in expenditure on incumbent importer v_f	-15.33	-5.85	-26.03
Change in expenditure on new entrant v_e	31.95	10.73	52.06
Change in the profits of the domestic firm π_d	-14.59	-10.39	-12.69
Change in the employment of the domestic firm L_d	-4.29	**23.86**	-22.23

4 Conclusions

We have developed a practical approach for modeling new import entry. With a handful of assumptions and limited data requirements, the model is able to provide an upper bound on the quantity of imports from new entrants after a tariff reduction. The calculation of an upper bound on the quantity of imports from the new source is especially useful when the marginal costs of the new entrants are not directly observable before the tariff reduction and must be inferred using the model.

If the new entrant is already supplying another market – either its domestic market or another export market – then data from this other market might provide additional information for estimating the quantity of new imports. In this case, the firm's marginal cost could be inferred from equilibrium expenditures in the other market and first order conditions like (6) and (7), and then the model could generate a *point estimate* for the quantity of imports from the new entrant using (23) and (26), rather than an upper bound.

The greatest limitation of the model is probably that it is a static framework. New entrants might be constrained in the short run as they ramp-up their shipments to the market. This is not captured in the model in this paper, which focuses on the new equilibrium after all adjustment has occurred. Modeling the adjustment process could be a useful direction for future research.

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