IMPORT STOCKPILING AND ANTICIPATED TARIFF CHANGES

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Abstract

We develop a sector-specific model that quantifies the reaction of imports to an anticipated future tariff increase. If it is economical to stockpile, there will be a surge in imports with the announcement of a future tariff increase and a magnified decline in imports after the tariff increase occurs. We demonstrate the model in a series of simulations. Several inputs of the model determine the magnitude of the changes in trade volumes and prices: the cost of storing the imports and domestic products from one period to the next, the magnitude of the future tariff increase, the production capacity available to increase imports and domestic production after the future tariff increase is announced, and the elasticity of substitution between imports and domestic products.

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1 Introduction

Trade can surge in anticipation of a future increase in tariff rates if it is economical to stockpile imports from one period to the next. A tariff that might be expected to improve the trade balance in the sector in the long run can worsen it in the short run. In this paper, we develop a sector-specific model of trade policy that captures some of these dynamics. The structural equations of the model are simple, in a way that ensures that the data requirements of the model are manageable. Section 2 describes the modeling framework.

In Section 3, we demonstrate the model in a series of simulations. Several inputs of the model determine the magnitude of the changes in trade volumes and prices, including the cost of storing the imports and domestic products from one period to the next, the magnitude of the future tariff increase, the production capacity available to increase imports and domestic production after the future tariff increase is announced, and the elasticity of substitution between imports and domestic products. Section 4 concludes.

2 Sector-Specific Modeling Framework

The model includes two sources of supply to the market, domestic firms (labeled d) and foreign firms (labeled f). There are three periods in the model: an initial period prior to the announcement of the future tariff change (period 0); the second period when the future tariff change is announced (period 1), and the final period when the new tariff rate is imposed permanently (period 2).

Consumers have CES preferences for foreign and domestic products, and there is perfect competition in the product market within each period. Equation (1) is the CES price index in the initial period (period 0).

$$P_0 = \left((p_{d0})^{1-\sigma} + \beta\ (p_{f0})^{1-\sigma}\right)^{\frac{1}{1-\sigma}} \tag{1}$$

β is a parameter that is calibrated to preference symmetries and any differences in the quality of the products. Equations (2) and (3) are the corresponding demand functions for the two products in the initial period.

$$q_{d0} = k\ (P_0)^{\eta}\ \left(\frac{p_{d0}}{P_0}\right)^{-\sigma} \tag{2}$$

$$q_{f0} = k\ \beta\ (P_0)^{\eta}\ \left(\frac{p_{f0}}{P_0}\right)^{-\sigma} \tag{3}$$

k is a demand parameter that is calibrated to the size of market. η is the price elasticity of total demand in the market. Equations (4) and (5) are the supply functions for the two products in this initial period. They have constant price elasticity of supply parameters θ_d and θ_f.

$$q_{d0} = \alpha_d\ (p_{d0})^{\theta_d} \tag{4}$$

$$q_{f0} = \alpha_f\ (p_{f0})^{\theta_f} \tag{5}$$

Equations (6) through (10) define the market equilibrium in period 1, when the future tariff change is announced.

$$P_1 = \left((p_{d1})^{1-\sigma} + \beta\ (p_{f1})^{1-\sigma}\right)^{\frac{1}{1-\sigma}} \tag{6}$$

$$q_{d1} = k\ (P_1)^{\eta}\ \left(\frac{p_{d1}}{P_1}\right)^{-\sigma} \tag{7}$$

$$q_{f1} = k\ \beta\ (P_1)^{\eta}\ \left(\frac{p_{f1}}{P_1}\right)^{-\sigma} \tag{8}$$

$$q_{d1} = \alpha_d\ (p_{d1})^{\theta_d} - z_{d1} \tag{9}$$

$$q_{f1} = \alpha_f\ (p_{f1})^{\theta_f} - z_{f1} \tag{10}$$

z_{d1} and z_{f1} represent inventory accumulated in period 1 in anticipation of the tariff increase in period 2.

Equations (11) through (15) define the market equilibrium in period 2 when the new ad valorem tariff t is imposed on imports.

$$P_2 = \left((p_{d2})^{1-\sigma}\ + \beta\ (p_{f2}\ (1+t))^{1-\sigma}\right)^{\frac{1}{1-\sigma}} \tag{11}$$

$$q_{d2} = k\ (P_2)^{\eta}\ \left(\frac{p_{d2}}{P_2}\right)^{-\sigma} \tag{12}$$

$$q_{f2} = k\ \beta\ (P_2)^{\eta}\ \left(\frac{p_{f2}\ (1+t)}{P_2}\right)^{-\sigma} \tag{13}$$

$$q_{d2} = \alpha_d\ (p_{d2})^{\theta_d} + z_{d1} \tag{14}$$

$$q_{f2} = \alpha_f\ (p_{f2})^{\theta_f} + z_{f1} \tag{15}$$

Equation (16) is the inter-temporal arbitrage condition that holds when there is stockpiling of imports.

$$p_{f1} = \frac{p_{f2}\ (1+t)\ (1-\delta_f)}{1+r} \tag{16}$$

δ_f is the ad valorem storage costs for imports, and r is the interest rate that discounts future revenues. The result of inter-temporal arbitrage of import prices is that the producer price in period 1 is equal to future prices, discounted by the interest rate and any storage cost but inflated by the tariff. Imports that are stockpiled in period 1 after crossing the border avoiding paying the tariff in period 2, but they sell at the higher price in period 2 due to the tariff on new imports that enter in that period. If the right-hand side of (16) is less than the left-hand side of the equation, there will be no stockpiling of imports.

Finally, Equation (17) is the inter-temporal arbitrage condition that holds when there is stockpiling in the domestic product.

$$p_{d1} = \frac{p_{d2}\ (1-\delta_d)}{1+r} \tag{17}$$

δ_d is the ad valorem storage costs for the domestic product.

The data requirements of the model are expenditures on the foreign and domestic products in the initial period, the storage costs (δ_f and δ_d), the interest rate (r), the new tariff rate (t), the demand elasticity parameters (σ and η), and the supply elasticity parameters (θ_d and θ_f).[1]

3 Illustrative Simulations

Table 1 reports a model simulation with relatively low storage costs and import stockpiling in advance of the tariff increase. Imports in period 1 are stored until period 2 and then sold to consumers at the elevated market price. When there is stockpiling, there are anticipatory

[1]Initial equilibrium quantities can be calculated from initial expenditures by normalizing initial prices to one.

effects on trade and prices in period 1. The prices of imports and the domestic product both increase, though the tariff increase is still in the future, and there is an increase in the quantity of imports and domestic shipments. In the example in the first column of Table 1, 14.91% of imports in period 1 are stockpiled for period 2 rather than consumed in period 1. In period 2, there is an increase in the consumer price of imports and the price of domestic products, relative to period 1, due to the tariff increase. There is an increase in the quantity of domestic shipments from period 1 to period 2 and a decline in the quantity of imports in period 2 that is magnified by the stockpiling of imports in period 1.

The second column in Table 2 demonstrates that it is not economical to stockpile imports if the tariff rate is smaller, only 10%. In this case, there are no anticipatory effects on prices or quantities in period 1. In period 2, the price and quantity effects of the smaller tariff all have the same sign as the effects of the larger tariff, but they are smaller in absolute value.

Table 2 demonstrates the sensitivity of the model to assumptions about storage cost and supply elasticity parameters. In the first column of Table 2, the storage costs of imports are higher than in Table 1. In this case, there is no stockpiling and no anticipatory effects on trade and prices in period 1. This is similar to the effects of a lower tariff. In the second column in Table 2, the storage costs of imports are low again but the supply elasticity of imports is now much lower than in the other simulations. A low import supply elasticity is another reason why it may not be economical to stockpile imports in anticipation of the tariff increase. The simulation in the third column increases the domestic supply elasticity, and in this case it is once again economical to stockpile imports.

Table 3 demonstrates the sensitivity of the simulations to assumptions about storage costs and tariff rates when the elasticity of substitution between imports and domestic products is mugh higher (8 rather than 4). In the simulation reported in the second column of the table, there are no storage costs on domestic products.[2] In this unusual case, there is no

[2]The storage cost is reduced from the already low 5% ad valorem rate in the other simulations.

stockpiling of imports but there is actually stockpiling of domestic products in response to the anticipated tariff increase.

4 Conclusions

Most changes in trade policy are anticipated. Announcements of future policy changes can trigger movements of trade volumes that can be predicted using a simulation model with dynamic features like stockpiling.

The sector-specific model presented in this paper provides a simple tool with limited data requirements. It estimates the increase in imports, stockpiling, and prices when a tariff increase has been announced but has not yet occurred, and it estimates the magnified decline in imports when the tariff increase actually occurs.

The model can be applied to data for a specific industry to predict or explain shifts in the pattern of trade around sudden changes in tariff rates or other trade policies. The model could be usefully extended to include other types of dynamic adjustment, including investment in production capacity and costly labor reallocation, depending on which features are most relevant in the specific industry that is modeled.

Table 1: Simulations with and without Import Stockpiling

Model Inputs		
Elasticity of Substitution	4	4
Price Elasticity of Total Industry Demand	-1	-1
Domestic Supply Elasticity	2	2
Import Supply Elasticity	5	5
Initial Market Share of Imports	50%	50%
Initial Tariff Rate	0%	0%
Anticipated Period 2 Tariff Rate	25%	10%
Storage Costs for Imports (Ad Valorem)	5%	5%
Storage Costs for Domestic Product (Ad Valorem)	5%	5%
Interest Rate for Discounting	5%	5%
Economic Effects in Period 1		
Import Stockpiling	Yes	No
Domestic Product Stockpiling	No	No
Change in the Producer Prices of Domestic Shipments	0.76%	0.00%
Change in the Producer Prices of Imports	2.33%	0.00%
Change in the Quantity of Domestic Shipments	1.53%	0.00%
Change in the Quantity of Imports	12.19%	0.00%
Fraction of Period 1 Imports Stockpiled	14.91%	0.00%
Economic Effects in Period 2		
Change in the Producer Prices of Domestic Shipments	3.22%	2.23%
Change in the Producer Prices of Imports	-11.58%	-2.73%
Change in the Consumer Prices of Imports	10.53%	7.00%
Change in the Quantity of Domestic Shipments	6.54%	4.50%
Change in the Quantity of Imports	-45.95%	-12.92%

Table 2: Sensitivity to Storage Costs and Supply Elasticities

Model Inputs			
Elasticity of Substitution	4	4	4
Price Elasticity of Total Industry Demand	-1	-1	-1
Domestic Supply Elasticity	2	2	5
Import Supply Elasticity	5	1	5
Initial Market Share of Imports	50%	50%	50%
Initial Tariff Rate	0%	0%	0%
Anticipated Period 2 Tariff Rate	25%	25%	25%
Storage Costs for Imports (Ad Valorem)	20%	5%	5%
Storage Costs for Domestic Product (Ad Valorem)	5%	5%	5%
Interest Rate for Discounting	5%	5%	5%
Economic Effects in Period 1			
Import Stockpiling	No	No	Yes
Domestic Product Stockpiling	No	No	No
Change in the Producer Prices of Domestic Shipments	0.00%	0.00%	0.42%
Change in the Producer Prices of Imports	0.00%	0.00%	2.12%
Change in the Quantity of Domestic Shipments	0.00%	0.00%	2.10%
Change in the Quantity of Imports	0.00%	0.00%	11.06%
Fraction of Period 1 Imports Stockpiled	0.00%	0.00%	14.05%
Economic Effects in Period 2			
Change in the Producer Prices of Domestic Shipments	5.07%	2.41%	1.88%
Change in the Producer Prices of Imports	-6.41%	-13.93%	-11.58%
Change in the Consumer Prices of Imports	16.99%	7.59%	10.53%
Change in the Quantity of Domestic Shipments	10.39%	4.87%	9.75%
Change in the Quantity of Imports	-28.19%	-13.93%	-45.95%

Table 3: Sensitivity to the Elasticity of Substitution

Model Inputs		
Elasticity of Substitution	8	8
Price Elasticity of Total Industry Demand	-1	-1
Domestic Supply Elasticity	2	2
Import Supply Elasticity	5	5
Initial Market Share of Imports	50%	50%
Initial Tariff Rate	0%	0%
Anticipated Period 2 Tariff Rate	25%	25%
Storage Costs for Imports (Ad Valorem)	30%	30%
Storage Costs for Domestic Product (Ad Valorem)	5%	0%
Interest Rate for Discounting	5%	5%
Economic Effects in Period 1		
Import Stockpiling	Yes	No
Domestic Product Stockpiling	No	Yes
Change in the Producer Prices of Domestic Shipments	0.00%	1.13%
Change in the Producer Prices of Imports	0.00%	0.41%
Change in the Quantity of Domestic Shipments	0.00%	2.27%
Change in the Quantity of Imports	0.00%	2.07%
Fraction of Period 1 Imports Stockpiled	0.00%	0.00%
Economic Effects in Period 2		
Change in the Producer Prices of Domestic Shipments	7.38%	5.00%
Change in the Producer Prices of Imports	-7.92%	-8.73%
Change in the Consumer Prices of Imports	15.10%	14.09%
Change in the Quantity of Domestic Shipments	15.31%	10.25%
Change in the Quantity of Imports	-33.81%	-36.67%