STRUCTURAL EQUATIONS FOR PE MODELS IN GROUP 3 (FOREIGN DIRECT INVESTMENT)

David Riker and Samantha Schreiber

U.S. International Trade Commission, Office of Economics

March 2020

Abstract

This paper presents the structural equations for the third group of industry-specific simulation models of changes in trade policy that are available for download on the USITC's PE Modeling Portal at `https://www.usitc.gov/data/pe_modeling/index.htm`.

 Please address correspondence to david.riker@usitc.gov.

1 Introduction

These spreadsheet models address various aspects of foreign direct investment.

2 Model with Foreign Affiliate Sales

The first model is based on Helpman, Melitz and Yeaple (2004) as modified in Khachaturian and Riker (2016). Z_{P0} and Z_{X0} are calibrated to the initial equilibrium in the market.

$$Z_{P0} = \left(\frac{n_f}{n_d}\right)\left(\frac{f_P}{f_D}\right)^{\frac{-\gamma}{\sigma-1}+1} = \left(\frac{A_0}{D_0}\right)\left(1 - {C_0}^{1-\sigma}\right)^{-\frac{\gamma}{\sigma-1}+1} \tag{1}$$

$$Z_{X0} = \left(\frac{n_f}{n_d}\right)\left(\frac{f_X}{f_D}\right)^{\frac{-\gamma}{\sigma-1}+1} = \left(\frac{M_0}{D_0}\right){C_0}^{\gamma} + {C_0}^{1-\sigma+\gamma}\left(1 - {C_0}^{1-\sigma}\right)^{\frac{\gamma}{\sigma-1}-1} Z_{P0} \tag{2}$$

The variables A_0, M_0, and D_0 represent the initial values of foreign affiliate sales, cross-border imports, and domestic sales. C_0 is the initial relative variable cost of delivering foreign services supplied to the domestic market, including variable international trade costs. f_P is the incremental fixed cost of foreign affiliate supply, f_X is the fixed cost of cross-border trade, and f_D is the fixed cost of provision by domestic suppliers. n_d and n_f are the number of domestic and foreign firms that can potentially supply the domestic market.[1] Again, σ is the elasticity of substitution, and γ is the shape parameter of the Pareto distribution of firm-specific productivity levels.

Changes in the fixed costs of trade affect Z_P and Z_X. Equations (3) and (4) are the updating equations.

$$\frac{Z_P - Z_{P0}}{Z_{P0}} = \left(1 + \left(\frac{-\gamma}{\sigma-1} + 1\right)\left(\left(\frac{f_P - f_{P0}}{f_{P0}}\right) - \left(\frac{f_D - f_{D0}}{f_{D0}}\right)\right)\right) \tag{3}$$

[1] n_d and n_f are treated as exogenous variables in the partial equilibrium model.

$$\frac{Z_X - Z_{X0}}{Z_{X0}} = \left(1 + \left(\frac{-\gamma}{\sigma - 1} + 1\right)\left(\left(\frac{f_X - f_{X0}}{f_{X0}}\right) - \left(\frac{f_D - f_{D0}}{f_{D0}}\right)\right)\right) \tag{4}$$

The equilibrium values of foreign affiliate sales (A), cross-border imports (M), and domestic sales (D) are defined by (5), (6), and (7).

$$A = \frac{E\ Z_P\ (1 - C^{1-\sigma})^{\frac{\gamma}{\sigma-1}-1}}{Z_P\ (1 - C^{1-\sigma})^{\frac{\gamma}{\sigma-1}}\ +\ Z_X\ C^{-\gamma}\ + 1} \tag{5}$$

$$M = \frac{E\ C^{1-\sigma}\left(Z_X\ C^{-\gamma+\sigma-1} - Z_P\,(1 - C^{1-\sigma})^{\frac{\gamma}{\sigma-1}-1}\right)}{Z_P\ (1 - C^{1-\sigma})^{\frac{\gamma}{\sigma-1}}\ +\ Z_X\ C^{-\gamma}\ + 1} \tag{6}$$

$$D = \frac{E}{Z_P\ (1 - C^{1-\sigma})^{\frac{\gamma}{\sigma-1}}\ +\ Z_X\ C^{-\gamma}\ + 1} \tag{7}$$

These three values sum to total expenditure on the industry in the market, E, which is held constant in model simulations.

3 Tariff-Jumping FDI Model

The second model is derived in Riker and Schreiber (2019), which is available for download on the PE Modeling Portal.

4 Export Platform FDI Model

The third model is derived in Riker and Schreiber (2019), which is available for download on the PE Modeling Portal.

5 Cross Border Ownership FDI Model

The fourth model is derived in Montgomery and Riker (2020), which is available for download on the PE Modeling Portal.

6 Model with Offshoring

In the fifth model, a partial equilibrium version of Grossman and Rossi-Hansberg (2008), there are two countries (d and f) and two types of workers (low-skilled workers L and high-skilled workers H). There is a continuum of tasks indexed by j. The model assumes that the cost of offshoring the two types of tasks, $1 + j$, are both uniformly distributed between zero and one.[2] The model calculates changes in the share of tasks offshored by skill level (J_H and J_L) and domestic employment by skill level (E_H and E_L), as well as the change in the product price (p). The model quantify the economic effects of exogenous changes in wage rates in the two countries (w_d and w_f) and the relative productivity of foreign workers within each skill type (λ_L and λ_H). The relative productivity of low-skilled workers overall (γ) is calibrated within the model.

$$J_L = \frac{w_d}{w_f \ \lambda_L} - 1 \tag{8}$$

$$J_H = \frac{w_d}{w_f \ \lambda_H} - 1 \tag{9}$$

[2]Grossman and Rossi-Hansberg (2008) do not assume a specific form for this distribution, but it is necessary to specify a distribution to generate a quantitative estimates in the model.

$$p^{1-\theta} = \left(w_d \left(1 - J_H\right) + \lambda_H w_f \left(\frac{1}{2} J_H^2 + J_H \right) \right)^{1-\theta} + \gamma \left(w_d \left(1 - J_L\right) + \lambda_L w_f \left(\frac{1}{2} J_L^2 + J_L \right) \right)^{1-\theta} \quad (10)$$

$$E_L = a_L \; k \; p^{\eta} \left(\frac{\gamma \left(w_d \left(1 - J_L\right) + \lambda_L \; w_f \; \left(\frac{1}{2} J_L^2 + J_L \right)^{1-\theta} \right)}{p^{1-\theta}} \right)^{-\theta} J_L \quad (11)$$

$$E_H = a_H \; k \; p^{\eta} \left(\frac{\left(w_d \left(1 - J_H\right) + \lambda_H \; w_f \; \left(\frac{1}{2} J_H^2 + J_H \right)^{1-\theta} \right)}{p^{1-\theta}} \right)^{-\theta} J_H \quad (12)$$

References

Grossman, G. and Rossi-Hansberg, E. (2008). Trading Tasks: A Simple Theory of Offshoring, *American Economic Review* **98**(5): 1978–1997.

Helpman, E., Melitz, M. J. and Yeaple, S. R. (2004). Exports versus FDI with Heterogenous Firms, *American Economic Review* **94**(1): 300–316.

Khachaturian, T. and Riker, D. (2016). A Multi-Mode Partial Equilibrium Model of Trade in Professional Services, *U.S. International Trade Commission Economics Working Paper* **No. 2016-11-A**.

Montgomery, C. and Riker, D. (2020). Modeling Tariff Policy in Concentrated Markets with Cross Border Ownership, *U.S. International Trade Commission Economics Working Paper* **No. 2020-01-A**.

Riker, D. and Schreiber, S. (2019). Modeling FDI: Tariff Jumping and Export Platforms, *U.S. International Trade Commission Economics Working Paper* **No. 2019-10-C**.