## partial equilibrium models

Partial equilibrium models are use to analyze trade issues in a single market or, alternatively, in a few closely-related markets. They are adaptations of standard supply and demand analysis to the specific features of trade policies. Partial equilibrium models are used in cases where linkages to other sectors of the economy are negligible enough to be ignored. They have the advantage of being relatively easy to construct and lend themselves to transparent application in policy analysis. They are extensively used in the analysis of anti-dumping and countervailing duties, as well as to assess the probable effects of many types of trade policy changes in narrowly-defined sectors.

A decision to not utilize partial equilibrium modeling (or the more involved approach of applied general equilibrium modeling) usually results in the deployment of some sort of trend analysis, which focuses on whether the direction and timing of changes in one set of economic variables are coincident with another set of economic variables. Trend analysis is sometimes implemented in the form of an interpolation based on trend lines before and after a critical event, such as a change in trade policy. Trend analysis has two problems, however. First, the causative links between the two sets of variables are never made explicit, and the relative contribution of one factor to a given set of events is therefore difficult to assess. Second, while the number of necessary parameter estimates is minimal, this is simply a consequence of the implicit assumptions embedded in the approach. Partial equilibrium analysis is a superior approach in almost all circumstances.

To construct a partial equilibrium trade policy model, the analyst first needs to determine whether the imported and domestic competing goods are perfect or imperfect substitutes and then needs to determine whether the country is “small” with reference to the rest of the world (in which case the import supply curve is horizontal or perfectly elastic) or “large” with reference to the rest of the world (in which case the import supply curve is upward sloping or less than perfectly elastic). These fundamental choices, which ideally should reflect the empirical reality of the situation being modeled, determine the appropriate modeling framework. If imports and domestic competing goods are best modeled as imperfect substitutes (following Armington, 1969), the transmission of shocks from the market for the imported good to the market for domestic goods relies on the cross-price elasticity of demand or, alternatively, the elasticity of substitution. This measure affects the extent to which changes in the price of an imported good affect demand for the domestic competing good. Partial equilibrium models, whether perfect of imperfect substitutes, are typically implemented using spreadsheet software examples of which are included in Francois and Hall (1997) and Roningen (1997).

**A Perfect Substitutes Model**

We will first consider a perfect substitutes model with “second-best” effects in the “small” country case. This model proceeds as indicated in the supply and demand diagram of Figure 1. The supply curve $S$ represents the behavior of domestic firm, and the demand curve $D$ represents the behavior of domestic firms. Imports are available from the world market at a constant price $P^W$. It is the constant nature of this price that puts us into the “small” country case. The domestic government has imposed a specific tariff on imports of amount $T_1$. At the resulting domestic price of $P^W + T_1$, imports are of an amount equal to $Z_1$. The policy change we are to consider here is an increase in this tariff of up to level $T_2$.

The supply and demand curves in Figure 1 are linear, that is, they can be expressed in the form of $Q = a + bP$. However, it is also common to use a constant elasticity functional forms, in which case the curves are expressed as $\ln Q = c + d \ln P$, where "ln" denotes the natural logarithm. In the former case, the price elasticities of demand and supply vary along the curves, while in the latter case, they are constant and equal to $d$.

The increase in the tariff level raises the domestic price to $P^W + T_2$ and reduces imports to $Z_2$. Consumer surplus (a measure of household welfare) falls by area $A + B + C + D$, and producer surplus (a measure of firm welfare) increases by area $A$. The government gains tariff revenue due to the increase of the tariff of area $C$ but also loses tariff revenue due to the reduction in imports of areas $E$ and $G$. Area $F$ is collected as tariff revenue both before and after the increase in the tariff. The net result of all these changes is that welfare as conventionally measured declines by $B + D + E + G$. Note also that the increase in domestic output from $Q_1$ along the supply curve can be easily translated into an increase in employment using a fixed employment-output ratio and that this change is often of key political interest.

Calibrating this simple model involves the same three elements that are used in more complex models: functional forms, initial values, and elasticities. In the present context, the functional forms are those of the supply and demand curves (either linear or constant elasticity) and the elasticities are those related to these functions. The elasticities are estimated prior to applying the model. With regard to initial values, the calibration can be made easier by defining the initial domestic price ( $P^W + T_1$ ) to be unity. Then the sum of the border value of the initial imports plus the initial tariff revenue gives the quantity $Z_1$ , and the value of domestic output give the quantity $Q_1$ . $Q_1$ determines the calibration point along the supply curve, and $Q_1 + Z_1$ determines the calibration point along the demand curve. This way of defining units is typical of applied trade policy models.

**Imperfect Substitutes Model**

We next consider an imperfect substitutes model in the "large" country case, allowing for terms of trade effects. This model is presented in Figure 2. The important difference between Figures 1 and 2 is that, in the imperfect substitutes framework of the latter, there are now *two* closely-related markets, one for the imported good $Z$ and another for the domestic competing good $D$. The demand curves in these two markets are related through the cross-price elasticity of demand (or alternatively the elasticity of substitution) between the two goods. The initial equilibrium in the absence of a tariff results in the two prices $P_{Z1}$ and $P_{D1}$ . The imposition of a specific tariff $T$ on imports of good $Z$ causes the supply curve of this good to shift upward by the amount of the tariff, raising the domestic price of the imported good along the demand curve. The increase in the price of good $Z$ affects the demand for good $D$, shifting the curve out as households substitute towards the domestic good. This increases the domestic price of good $D$ in turn causes a substitution towards good $Z$ and a shift out of the demand curve for imports. These two substitution effects are simultaneous, and the resulting, new prices are $P_{Z2}$ and $P_{D2}$ .

We next consider the welfare effects of the tariff in this imperfect substitutes framework. In the market for the domestic good, there is an increase in producer surplus along the supply curve equal to trapezoid $H$ (extending from the vertical price axis all the way to the supply curve). This entire area, however, comes as a cost to the consumers, with the producer gain and the consumer loss exactly offsetting each other. In the market of the imported good, there are no domestic producers to account for. However, the estimation of the consumer welfare effect is troubled by the fact that both the supply curve and the demand curve in the market for good $Z$ have shifted. The standard approach to this, introduced by analysts such as Morkre and Tarr (1980), is to measure the change in consumer surplus along the presumed path between the initial and final equilibria points. The resulting consumer surplus loss is the trapezoid $I + J$. Rectangle $I$ represents an increase in tariff revenue, so the net welfare effect in Figure 2 is just triangle $J$.

One important aspect of Figure 2 is that, discounting for the effect of the shift of the demand curve, the rise in the domestic price of the imported good is less than the tariff. This is because there is a movement in world quantity supplied down $S_Z$ and a resulting decline in the border price of the imported good. This is the terms-of-trade effect of the tariff is missing in Figure 1. The terms of trade effect has the property of reducing the height of the net welfare triangle $J$ and is present unless the import supply curve $S_Z$ is horizontal or infinitely elastic, putting us back into a “small” country case.

As in the perfect substitutes model, the increase in domestic output along $S_D$ can be easily translated into an increase in employment using a fixed employment-output ratio, and calibration to the initial equilibria points can be made easier by defining the initial domestic prices of the imported and domestic goods to be unity.

**Summary**

Partial equilibrium modeling of trade policy changes will continue to be an important analytical tool for situations where the linkages of the trade policy change to the broader economy under consideration are weak. Despite some complications in the imperfect substitutes case, the models are relatively easy to implement in spreadsheet form and are widely used by trade policy analysts.

*See also: Applied General Equilibrium Models, Gravity Models, Quotas, Tariffs*

**Further Reading**

Anderson, Kym. 1992. "The Standard Welfare Economics of Policies Affecting Trade and the Environment," in *The Greening of World Trade Issues*. Kym Anderson and Richard Blackhurst, eds. Ann Arbor, Michigan: University of Michigan Press, 25-48. A noted application of partial equilibrium modeling to the issue of trade and the environment.

Armington, Paul. 1969. "A Theory of Demand for Products Distinguished by Place of Production." *IMF Staff Papers* 16(3): 159-176. The key contribution on product differentiation by country of origin used in partial equilibrium trade policy modeling.

Baldwin, Robert E. and Tracy Murray. 1977. “MFN Tariff Reductions and Developing Country Trade under the GSP,” *Economic Journal* 87(345): 30-46. An early application of partial equilibrium trade policy modeling applied to the General System of Preferences using the imperfect substitutes model.

Francois, Joseph F. and H. Keith Hall. 1997. “Partial Equilibrium Modeling,” in *Applied Methods for Trade Policy Analysis: A Handbook*. Joseph F. Francois and Kenneth A. Reinert, eds. Cambridge: Cambridge University Press, 122-155. A more advanced introduction to partial equilibrium trade policy modeling.

Morkre, Morris E. and David G. Tarr. 1980. *Effects of Restrictions on United States Imports: Five Case Studies and Theory*. Washington, DC: United States Federal Trade Commission. An early application of the imperfect substitutes model to United States trade policy.

Reinert, Kenneth A. and David W. Roland-Holst. 1992. “Armington Elasticities for United States Manufacturing Sectors.” *Journal of Policy Modeling* 4(2), 631-639. The first estimation of elasticities of substitution between imported and domestic competing goods.

Roningen, Vernon O. 1997. “Multi-Market, Multi-Region Partial Equilibrium Modeling,” in *Applied Methods for Trade Policy Analysis: A Handbook*. Joseph F. Francois and Kenneth A. Reinert, eds. Cambridge: Cambridge University Press, 231-299. An introduction to the extension of partial equilibrium trade policy modeling to multiple markets and multiple regions.

Rouslang, Donald J. and John W. Suomela. 1988. “Calculating the Welfare Costs of Import Restrictions in the Imperfect Substitutes Model.” *Applied Economics*

20(5), 691-700. An often cited study using the imperfect substitutes version of the partial equilibrium model.

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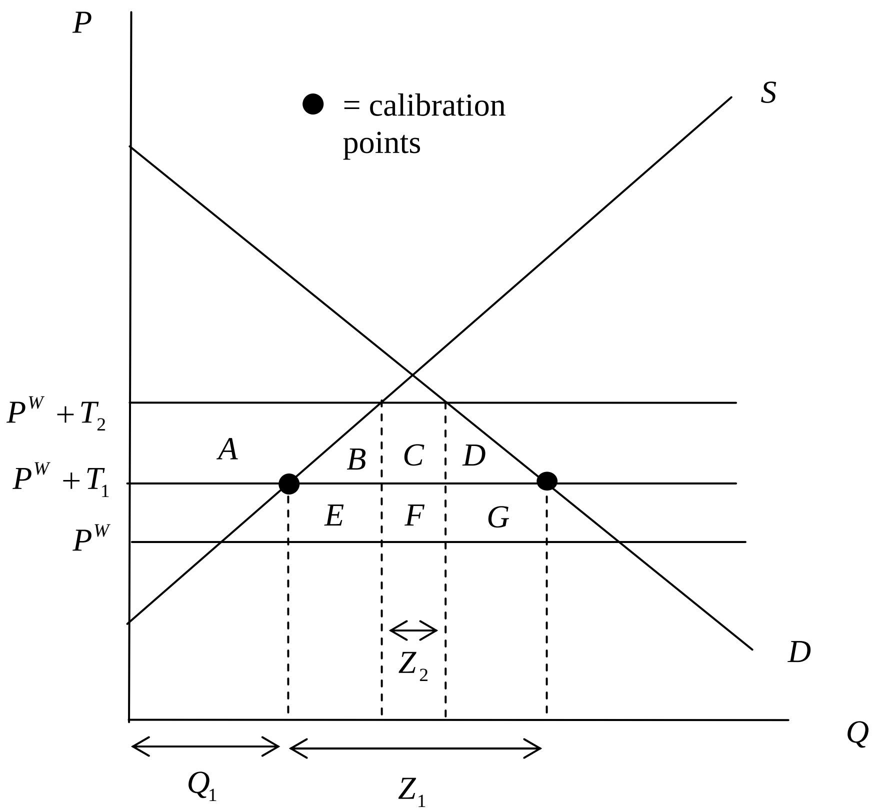


Figure 1. A Small-Country, Perfect-Substitutes Model

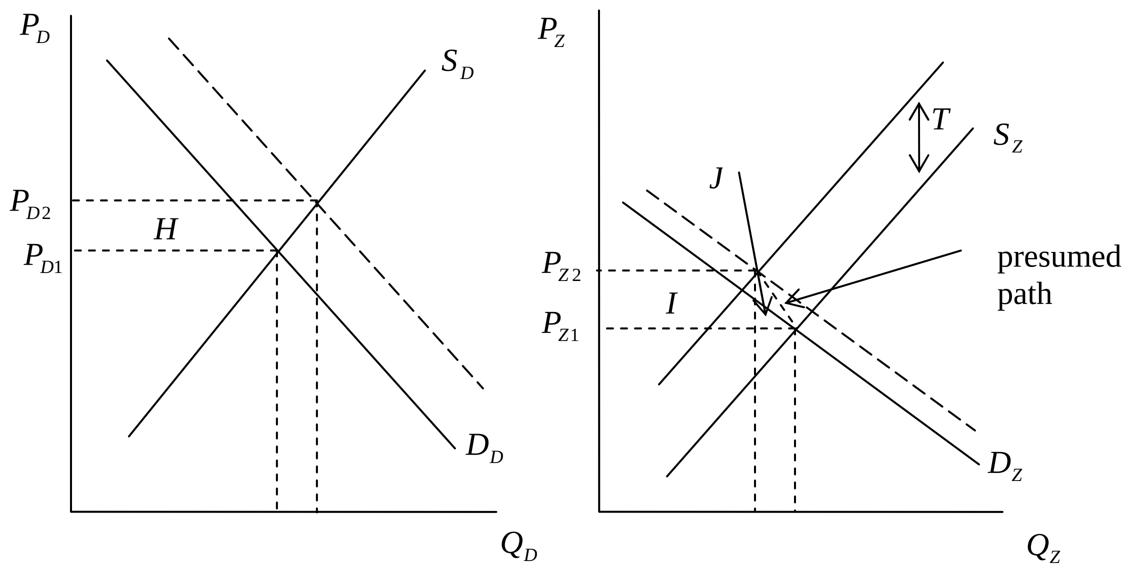


Figure 2. A Large-Country, Imperfect-Substitutes Model