Appendix
Measuring the Scale of Production

The static version of hypothesis 5, discussed in chapter 2, anticipates that industries with scale disadvantages compared to foreign competitors are likely to support external trade protection. To evaluate this hypothesis statistically, chapters 3 and 4 employ an index of unit costs (labeled *Scale*) derived from data on relative scales of production and engineering estimates of the returns to scale.

In general, unit costs with economies of scale are given by

$$\text{Unit costs} = \beta x^n,$$

where β is a constant, x is the position on the cost curve, and n is the slope of the cost curve. Following this rule, an index of relative costs can be computed as

$$\text{Unit cost}_{i,j} = \beta(x_i / x_j)^n,$$

where x_i is the scale of output in country i and x_j the scale of output in country j.

As an example, consider the British and U.S. tire industries in 1930. On a per factory basis, Britain produced 347,514 tires (table 8) and the United States produced 860,858 tires (table 13). In engineering estimates, tire production at one-half of MES increases unit costs by 5 percent compared to MES levels; assuming a constant elasticity of unit cost with respect to scale, this implies a slope of -0.07. Thus, the cost indices are

$$\text{Britain:} \quad (347{,}514 / 860{,}858)^{-0.07} = 1.065$$

$$\text{United States:} \quad (860{,}858 / 347{,}514)^{-0.07} = 0.938$$

The cost index will converge toward 1 when scales are nearly equal or returns to scale are small. Figures greater than 1 indicate cost disadvantages, while figures less than 1 indicate cost advantages. *Scale* therefore should be positively correlated with measures of external trade protection, such as tariff rates.