

A New Interregional Input-Output Model with Endogenous Self-sufficiency Rate

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Classic input-output models often assume that domestic and imported products are either perfectly substitutable or non-substitutable in measuring the effects of external demand shocks. However, these assumptions do not fully reflect real-world trade patterns. In this paper, we assume that domestic and imported products of the same sector are differentiated products therefore whose elasticity of substitution is non-zero. Based on this assumption, we develop a new interregional input-output model that allows for a constant elasticity of substitution between domestic and imported products by supposing each industry has a Cobb-Douglas production function and intermediate inputs of each industry has a Constant Elasticity of Substitution (CES) aggregator over domestic and imported products. One attractive aspect of our model is that the self-sufficiency rate of intermediate inputs is endogenized by profit maximization of all firms which is determined by both substitution elasticity between domestic and imported products and the international price indices. The new model could provide a more flexible framework to analyze the effects of external demand shocks.

To empirically check the differences in the results of measuring the effects of external demand shocks between our model and the classic Interregional Input-output model, we focus on demand-side shocks which refer to changes in exports from representative industries the between China and the U.S. Operating the new model need to assign values to three types of parameters for: the input coefficient matrix, the relative price level among countries and the elasticity of substitution between countries of each sector. We use the 2014 World Input-Output Database (WIOD) to construct a three-region, 56-sector IRIO table covering China, the United States, and the rest of the world (ROW) to get the input coefficient matrix required. The information of the relative price level among countries comes from the cross-country price indices of the United Nations International Comparison Program (ICP) and the distribution range of the elasticity of substitution between domestic and imported products from the existing empirical results of the Armington elasticity.

The results indicate that the shocks estimated by the new model have a lower impact on China's value-added compared to the classic model but a higher impact on the U.S.' value-added than the classic estimate. At the sectoral level, the two models identify significantly different sectors as the most affected by trade shocks. To observe the impact of changes in the elasticity of substitution on external demand shocks, we add two scenarios for simulation: a) a high substitutability relationship between domestic and imported products; b) a low substitutability relationship between domestic and imported products. By comparing the simulation results, we find that changes in the elasticity of substitution affect the estimation of the shock's impact, but the classic model consistently provides higher estimates of the impact on China's value-added and lower estimates of the impact on the U.S.' value-added compared to the new model.

Key words: Interregional input-output model; Armington Elasticity; Relative Price Level among Countries; External demand Shock; Self-sufficiency Rate