Aggregation and Applied Trade Theory

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Abstract

The influence of data aggregation on applied trade theory may not be generally appreciated. Aggregation can have a direct impact on the direction of trade, factor intensity, factor abundance, factor substitution, product differentiation, and intra-industry trade. This paper develops some propositions for applied trade theorists on the effects of aggregation.

• JEL Classifications: F10, F11, F12

• Key words: Aggregation, Applied trade theory, Homogeneous, Heterogeneous, Intra-industry trade

I. Introduction

Explaining the observed trade patterns with only homogenous products requires too much fine tuning of technology to be convincing. The broad structure of world trade is more naturally explained with the aid of product differentiation than without it. (Elhanan Helpman, 1999)

A preliminary issue for applied trade theorists is the choice between models with homogeneous and heterogeneous products. The level of data aggregation would ideally describe the issue at hand with minimal theoretical structure. Aggregation leads to simpler models and data sets but creates distortions by including increasingly dissimilar products in the same categories.

In the applied trade literature, the observation of intra-industry has been used to motivate the theory of product differentiation. Intra-industry trade, however, occurs for the simple reason that even the finest categories in standard industrial
classifications contain different products. There are other distortions due to aggregation. Data on factors of production is highly aggregated, and regional aggregation can disguise underlying patterns of production and trade.

Various issues that arise in applications are clarified by focusing on the effects of aggregation. Examples in the present paper develop a series of working propositions on aggregation and applied trade theory.

II. Aggregation and Product Differentiation

Suppose we start with the unrealistic assumption that products are separated at the ideal level with the product vector $P_n = \{g_i\}, i = 1,...,n$. A red 2002 Ford F150 pickup truck with a regular cab, 2-wheel drive, 120 inch wheelbase, V6 4.2 liter engine, style side body, manual 5 speed transmission with overdrive, air conditioning, front and rear antilock brakes, and cloth seats would be in a separate category from a blue one. The order $n$ of the product vector $P_n$ is large but finite.

Assume products are ranked next to their closest substitute in consumption, with beef closer to pork than leather. Each product is a perfect substitute with itself and a closer substitute for products closer to it in $P_n$.

Let $^cP_n$ represent a partition of $P_n$ into $c$ categories. A partition is a collection of disjoint subsets. The standard in macroeconomics is $^1P_n$ or simply $P_n$, useless for trade theory because there must be at least two products to trade. For trade theory, $^2P_n$ might be $\{\{\text{exports}\}, \{\text{imports}\}\}$ or $\{\{\text{goods}\}, \{\text{services}\}\}$.

Consider partitions that do not skip products. With two products, there is only one partition. With three products, there are three partitions

$^1P_3 = \{g_1, g_2, g_3\}$

$^2P_3_1 = \{\{g_1, g_2\}, g_3\}$

$^2P_3_2 = \{g_1, \{g_2, g_3\}\}$

Note there is no $\{g_1, g_3\}$ aggregate because $g_2$ is between them in $P_3$. Given a desire to aggregate, $^2P_3_1$ would be chosen if $g_2$ is a closer substitute for $g_1$ than $g_3$.

Suppose country 1 exports $g_1$ and $g_2$ to country 2 in exchange for $g_3$. There is only interindustry trade with $^2P_3_1$, but there is intra-industry trade with $^2P_3_2$ as pictured in Figure 1.

**Proposition 1.** Intra-industry trade depends directly on aggregation.

With four products, there are six partitions

$^1P_4 = \{g_1, g_2, g_3, g_4\}$

$^2P_4_1 = \{\{g_1, g_2\}, g_3, g_4\}$

$^2P_4_2 = \{g_1, \{g_2, g_3\}, g_4\}$

$^3P_4_1 = \{\{g_1, g_2\}, \{g_3, g_4\}\}$

$^3P_4_2 = \{g_1, \{g_2, g_3\}, \{g_4\}\}$

$^3P_4_3 = \{g_1, g_2, \{g_3, g_4\}\}$

$^3P_4_4 = \{g_1, \{g_2\}, \{g_3, g_4\}\}$

$^3P_4_5 = \{g_1, \{g_2, g_3\}, g_4\}$

$^3P_4_6 = \{g_1, \{g_2\}, \{g_3, g_4\}\}$

$^4P_4 = \{g_1, g_2, g_3, g_4\}$