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Asymmetric adjustment costs in simple general equilibrium models

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Abstract

This paper demonstrates that the introduction of asymmetric adjustment costs in a simple general equilibrium framework establishes a meaningful link between factor price determination and output determination, breaking the analytically convenient dichotomy of the Heckscher–Ohlin–Samuelson model. The possibility of trade between seemingly similar countries that differ in their adjustment technologies is visited.

JEL classification: F1; D5

Keywords: General equilibrium; International trade; Heckscher–Ohlin–Samuelson theory; Adjustment costs; Factor price determination

1. Introduction

The role of adjustment costs in a general equilibrium model is widely recognized.[1] A number of econometric studies have also provided estimates of adjustment costs.[2] However, there is no compelling reason to believe that such adjustment costs will be

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[1] For an early treatment of adjustment costs of investment see Lucas (1967) where he suggested that this cost behavior can be thought of as a sum of purchase costs (with perfect or imperfect factor markets) and installation costs. Mussa (1978) was the first to recognize the role of economic resources in the movement of capital from one sector to another. He demonstrated how a balance between expectations of future returns and costs of capital movement determine the efficiency of the adjustment process. See Mulligan and Sala-i-Martin (1993) for an insightful discussion on this issue.

[2] See Barnett and Sakellaris (1999), Kolstad and Lee (1993), Wolfson (1993), Zanias (1991), Bernstein (1988), Lichtenberg (1988), Mohnen et al. (1986), and Pindyck and Rotemberg (1983) for representative estimates of adjustment costs.

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uniform across sectors.[3] This paper demonstrates that the introduction of asymmetric adjustment costs in an otherwise Heckscher–Ohlin–Samuelson (H–O–S) model establishes a meaningful link between factor price determination and output determination, breaking the analytically convenient dichotomy. In consequence, the possibility of the emergence of a trading equilibrium between two economies that differ in their adjustment technologies but are otherwise identical is demonstrated.

The rest of the paper is organized as follows. Section 2 presents a diagrammatic analysis of the effects of asymmetric adjustment costs. It provides a useful taxonomy for the formal model presented in Section 3. Section 4 concludes.

2. A diagrammatic analysis

Visualize a small open economy that uses two factors (in fixed supply), capital (K) and labor (L) to produce two goods, X (labor intensive) and Y (capital intensive), with constant returns to scale technology. Let x and y denote the quantities of X and Y, respectively. Let w denote the purchase price of labor and r the purchase price of capital, K_j and L_j denote the capital and labor employed in sector j, P_j denote the world price of good j, where $j=X,Y$. Labor is freely mobile between sectors. Capital is a quasi-fixed input in the sense that adding new capital, removing existing capital and/or moving capital from one sector to another entails an adjustment cost. Moving capital from one sector to another is viewed as a two-step process: (1) Removal: Capital is removed from one sector, the cost of which is borne exclusively by that sector and (2) addition: The released capital is transformed and installed in the other sector, the cost of which is borne exclusively by the recipient sector. To focus on the asymmetry in adjustment costs *between* sectors I ignore any difference in adjustment cost (a) between addition of capital to a sector and removal of capital from the same sector and (b) between addition of new capital to a sector and addition of capital to the same sector released by the other. For simplicity, I also assume that capital is the only resource used up in the installation and implementation of capital.

Consider an expansion in the endowment of capital. Let the marginal cost of adjustment be higher in the capital-intensive sector relative to the labor-intensive sector. Let a_j denote a constant marginal cost of adjustment in sector j. In transition, the factor cost ratios faced by the producers of X and Y goods will then bear the following relationship:

$$(w/r) > [w/(r+a_X)]_X > [w/(r+a_Y)]_Y. \tag{1}$$

[3] Chakrabarti (1999) presents evidence from U.S. industries that indicate systematic Differences in costs of adjustment associated with the introduction of new capital across sectors differing in factor-intensities. A panel of annual observations on 457 industries by 4-digit SIC in the U.S. economy over the period 1958–1994 indicates that, on an average, the estimated cost of adjustment is significantly higher in the capital-intensive sectors than it is in the labor-intensive sectors. A panel of annual observations on 521 firms from the U.S. economy over the period 1984–1992 leads to a similar conclusion: the estimated cost of adjustment is significantly higher in the relatively capital-intensive group of firms than it is in the labor-intensive group. Benoit and Serena (1992) also report significant differences in the speed and the costs of adjustment in Canadian industries.