

Measuring Technology Shocks using the Field of Influence Approach to Input-Output Analysis: Applications to the 1997 Asian Crisis

Topic:

Author: Norman De Guzman Dytianquin

A key assumption of input-output analysis is that the inverse of technical coefficients are fixed and yet the inverse coefficients change over time. The proponents of the field of influence approach to input-output analysis [i.e., Hewings, Sonis & Jensen (1988)] assume that this change in coefficients represent technological change as given a fixed share of inputs equaling unity, sectors compete for shares of inputs when producing their outputs. The field of influence approach comprises equations that simply show that the matrix of technical coefficients for a given year should equal the sum of three parts: a) the matrix of technical coefficients of a reference year arranged as a direct field of influence where the entire matrix is just the product of all elements rearranged into row and column vectors; b) the total product of the direct field of influence matrix multiplied by the sectoral changes in technical coefficients; and c) the synergetic effect of both parts above calculated by multiplying the direct field of influence matrix by the reciprocal of the ratio of the determinant of the original (reference or base year) inverse matrix of technical coefficients to the determinant of the matrix of changes in the technical coefficients between the base year and the year under study. Given a longer time series of input-output tables, the changes in coefficients can depict as well waves of technological diffusion across industries.

The application of the field of influence approach can be extended not only to investigate the role of technology in growth episodes but the propagation of economic shocks in line with real business cycle or RBC theory. While most episodes of economic crisis are driven by monetary impulses, RBC theory looks at technological shocks as alternative explanation to why economies fluctuate with resulting effects on productivity. Relating the change in coefficients to economic crisis, the conceptual framework uses network theory where propagation of sector-specific shocks analogous to new technologies diffusing across sectors in the case of growth, spreads like a virus throughout the economic system through a web of sectoral interdependencies in the case of crisis. This propagation mechanism which is conceptually associated to RBC theory could moreover be linked to the bullwhip effect where upstream or supplying sectors are adversely affected by supply shocks and downstream or buying sectors by demand shocks. The bullwhip effect shows the cyclical sensitivity of sectors across the supply chain to business cycles, with upstream or supplier industries most affected due to demand uncertainty and problems associated with forecasting demand and the need to supply buffer stocks to satisfy this demand downstream.

The study focuses on three developing economies affected by the 1997 Asian crisis – Malaysia, Thailand and the Philippines – and applies the field of influence approach to this crisis episode. The debate on the origins of the Asian crisis revolves around the structuralist/fundamentalist versus the contagion/panic positions where the former adheres to the view that these Asian crisis economies are macro-economically flawed as evidenced by balance of payments deficits, short term external debt accumulation, banking troubles beset with property bubbles and corporate governance problems. The opposing view believes in a pure contagion occurring from asymmetric information notwithstanding economic fundamentals remaining sound. While both sides to the debate indicate the Asian crisis episode as monetary in substance, there was no role ascribed to real shocks in attempting to explain the causes of the Asian crisis consonant with RBC theory.

Using two models of the network propagation mechanism of RBC theory, the economic crisis that befell these three economies in 1997 could be played out by supply shocks. These supply shocks were pronounced in the semiconductor industry classified in the national accounts under electrical

machinery where the three countries competed as assemblers in the global supply chain. The semiconductor industry are among three sectors, the other two being transport equipment (automotive) and textiles/wearing apparel, which became archetypes of an emerging development paradigm of global production networks, also referred to as supplier-oriented model of development. Possible supply shocks that impacted the semiconductor industry were the rapid miniaturization of the microchip in the latter half of the 1990s in accordance with Moore's law, the emergence of China as a favorite destination for foreign investments in the electronics industry, the drop in electronics prices and the Japanese property bubble in early 1990 that affected supplier industries in terms of tighter financing and shrinking capital flows of Japanese banks into Japanese corporations that purchased these chips from the Asian economies.