

# **Growth in Open Economies, Schumpeterian Models**

by

Elias Dinopoulos  
(University of Florida)  
[elias.dinopoulos@cba.ufl.edu](mailto:elias.dinopoulos@cba.ufl.edu)

Current Version: November 2006

Kenneth Reinert and Ramkishen Rajan (eds), *Princeton Encyclopedia of the World Economy*, Princeton University Press, forthcoming.

Paper available at <http://bear.cba.ufl.edu/dinopoulos/Research.html>

## **Introduction**

Schumpeterian growth is a particular type of economic growth which is generated by the endogenous introduction of product and/or process innovations. The term “endogenous” refers to innovations that result from R&D investments undertaken by forward-looking, profit-seeking firms. The term “Schumpeterian growth” is used to honor Joseph Schumpeter who described the evolution of capitalism through a process of creative destruction. This process serves as the fundamental building block in Schumpeterian models of growth and captures the social benefits that result from the endogenous destruction of old products and processes by new ones: “Economic progress, in capitalist society, means turmoil. And, ...in this turmoil competition works in a manner completely different from the way it would work in a stationary process, however perfectly competitive. Possibilities for gains to be reaped by producing old things more cheaply are constantly materializing and calling for new investments. These new products and new methods compete with the old methods not on equal terms but at a decisive advantage that may mean death to the latter” Schumpeter (1942,

page 42). Schumpeterian growth models are closer in spirit to Schumpeter's ideas than other theoretical approaches to economic growth such as those that emphasize learning-by-doing, human capital accumulation or physical capital accumulation as sources of economic growth.

The development of Schumpeterian growth theory started in the early 1990s motivated by the divergence of national growth rates, Japan's challenge of the United States technological leadership, and the inability of the neoclassical growth theory to account for the long-run causes of technological progress. The graduate textbook of Aghion and Howitt (1998) provides a comprehensive survey of the new growth theory which has primarily focused on causes and effects of long-run technological progress which is the sole determinant of long-run growth of income per-capita.

First-generation models of Schumpeterian growth exhibit a counter-factual "scale-effects" property according to which more resources devoted to R&D are associated with a higher growth rate of total factor productivity (TFP) growth. In these models, the presence of a positive population growth rate results in unbounded (infinite) long-run growth rate of per-capita income. Since the mid 1990s, growth theorists have developed a second generation of scale-free, Schumpeterian-growth models which fall into two distinct categories depending on the way of removing the scale effects property. Semi-endogenous Schumpeterian-growth models incorporate diminishing returns to the stock of knowledge that affects the productivity of R&D resources by assuming that, as technology becomes more complex, sustained growth in R&D resources is needed to maintain a given rate of TFP growth. Semi-endogenous growth theory predicts that the long-run growth rate of TFP depends only on the

rate of population growth and therefore it is not affected by policy-related parameters. In other words, semi-endogenous growth theory generates exogenous scale-free long-run Schumpeterian growth. The second category of R&D-based growth theory consists of fully-endogenous scale-free Schumpeterian growth models. This approach to the removal of scale effects builds on the insight that aggregate R&D effort becomes less effective either because it is spread among more product lines (as new varieties are discovered), or because incumbents who face a risk of going out of business raise barriers to frustrate the R&D effort of challengers. Fully-endogenous Schumpeterian growth models maintain the assumption of constant returns to the stock of knowledge of earlier endogenous growth models and generate endogenous long-run growth. In other words, with the exception that the size of an economy- measured by its population level- does not affect long-run growth, these models share the same properties as earlier endogenous growth models. Although the evidence against the empirical validity of earlier endogenous growth models is convincing, the ongoing debate on whether semi-endogenous or fully-endogenous Schumpeterian growth models are more empirically relevant is inconclusive. Dinopoulos and Thompson (1999) and Jones (1999) provide overviews of the scale-effects problem, solutions, and implications. The terms “earlier”, “semi” and “fully” endogenous growth models will be used to refer to first generation, scale-free exogenous , and scale-free endogenous Schumpeterian growth models respectively to conserve space and to clarify the exposition.

Models of Schumpeterian growth in open economies constitute the backbone of dynamic trade theory and complement the traditional trade theory by focusing on the analysis of the economic forces that determine the generation and international transfer of technology. They

provide valuable theoretical insights to understanding the patterns of growth and trade, global income distribution and poverty, and the effects of economic policies on the performance of the global economy.

## **Economic Openness and Growth**

Earlier models of Schumpeterian growth in open economies analyzed the nexus between trade patterns and long-run growth using a variety of approaches. They generated product-cycle trade, which is based on the observation that many products are first discovered in advanced countries and then their production shifts to less advanced countries as their technology is imitated, within a context of a high-wage innovating North and a low wage non-innovative South, or within the context of two Northern economies facing equal factor prices but differing in their factor endowments. They also identified the economic determinants of sustained comparative advantage in high-technology industries: Countries with higher comparative labor productivity in R&D activities, or countries which are abundant in factors used intensively in R&D, such as human capital, will export high-tech products to the rest of the world (Segerstrom, Anant, Dinopoulos, 1990; Taylor, 1993; Grossman, Helpman, 1991, chapters 7, 12; Dinopoulos, Oehmke, Segerstrom, 1993).

Schumpeterian models have also analyzed the determinants of growth in open economies. Earlier endogenous growth models identified three broad channels which transmit the effects of economic openness to long-run growth. First, trade, by increasing the size of the market, raises the profitability of R&D investment and increases the long-run rate of innovation and growth in all trading countries. Second, economic openness, by facilitating the exchange of

information, increases the scope of knowledge spillovers, raises the productivity of researchers and accelerates the rates of innovation and growth in the global economy. Third, trade openness, by reallocating economic resources across sectors and between R&D investment and manufacturing activities, affects the long-run rates of innovation and growth. This trade-induced “specialization” process, which the major source of welfare gains in static models, has an ambiguous effect on long-run growth. For, example, Grossman and Helpman (1991, Chapter 6) have established that free trade could shift labor from R&D to manufacturing and could slow down long-run growth.

It should be noted, however, that the market-size based effect of trade on growth can be traced to the scale-effects property of earlier endogenous growth models. Fully-endogenous growth models predict more moderate effects of economic openness on growth that work through changes in relative prices and per-capita reallocation of resources between R&D and manufacturing activities, instead of market-size based expansion of the research sector. For example, a reduction in international trade costs can accelerate the long-run rate of growth among similar developed economies by increasing the flow of monopoly profits and by shifting per-capita resources from manufacturing to R&D investment. (Dinopoulos and Segerstrom, 1999).

## **Globalization and Income Distribution**

Schumpeterian models of economic growth have provided valuable theoretical insights associated with the evolution of wage-income inequality within and across countries. The 1970s and 1980s witnessed an alarming rise in the demand for skilled labor and a decline in

the demand for unskilled labor. These labor-market developments raised the relative wage of skilled workers in the United States and several developing countries and increased the unemployment rate of less-skilled workers in several advanced countries. Economic openness and skilled-biased technological change have been proposed as two competing explanations for the rise in the relative demand for skilled labor. In traditional trade theory, relative commodity prices represent the only channel that transmits the effects of trade on wages. The traditional trade-theory-based explanation for the rise in US wage inequality has been rejected by evidence on the United-States relative prices which have remained more or less constant during the period of rising wage inequality. Unlike traditional trade theory, Schumpeterian growth theory views technological change as an endogenous process which could be affected by changes in the reward to innovation. The reward to innovation is proportional to the expected discounted profits associated with the discovery of new products. An increase in trade openness caused by a reduction in international trade costs can affect the profitability of R&D without necessarily causing any change in relative commodity prices. Under the reasonable assumption that R&D is a skilled-labor intensive activity, Schumpeterian growth models predict that globalization will increase the relative demand for skilled labor and accelerate the rate of technological progress. An increase in the relative demand for skilled labor can generate either a rise in the relative wage of skilled workers or a rise in the unemployment rate of less-skilled workers depending on the degree of labor-market flexibility. This novel mechanism has been formally established in the context of semi-endogenous and fully-endogenous Schumpeterian models of economic growth (Dinopoulos and Segerstrom, 1999; Sener, 2001)

The controversial issue of the dynamic effects of various components of globalization on the income gap between advanced (North) and poor countries (South) has drawn the attention of Schumpeterian growth theorists. Following Krugman's (1979) seminal work on product cycle trade and world income distribution between an innovating North and a non-innovative South, a strand of Schumpeterian models of North-South trade and growth has analyzed the income distributional effects of globalization-enhancing policies. The main insight of this literature is that any increase in the rate of imitation and/or decline in the rate of innovation improves the North-South wage-income inequality measured by the Northern relative wage. In other words, faster international transfer of technology from North to South improves the global wage-income inequality.

## **Government Interventions**

Schumpeterian models of economic growth have analyzed the long-run growth and welfare effects of a variety of government interventions. Policy instruments such as R&D, production, and trade taxes cum subsidies change relative product and factor prices and generate shifts in economic resources between consumption and R&D activities. In earlier and fully endogenous growth models, a policy-induced shift in per-capita resources towards R&D activities accelerates permanently the rates of innovation and growth. In semi-endogenous growth models this resource shift generates a temporary increase in the rate of innovation. Dinopoulos and Segerstrom (1999) and Segerstrom et al. (1990) formally analyze this mechanism in the case of structurally identical industries and countries. Grossman and Helpman (1991, Chapter 10) emphasize that, in the presence of asymmetric industries and countries, general equilibrium interactions can reverse the desired effects of several policy

interventions.. For instance, an R&D subsidy may cause a country to export fewer R&D-intensive goods and import more of them, and industrial policies that subsidize manufacturing activities in high-technology sectors may have detrimental effects on global long-run innovation and growth because they could raise the costs of R&D.

Several North-South Schumpeterian growth models have analyzed the dynamic effects of stronger protection of intellectual property rights (IPR). Stronger protection of intellectual property has been modeled as either an increase in patent length as in Segerstrom et al. (1990) or a reduction in the rate of Southern imitation as in Krugman (1979). Stronger IPR protection reduces the rate of international technology transfer from innovating North to imitating South, raises the North-South wage gap, and has an ambiguous effect on the rate of innovation and global growth. For example, in Segerstrom et al. (1990) longer globally enforced patents offered to high-wage Northern firms shift resources from R&D investment to production of high-technology goods and slow down the long-run rates of innovation and growth. Helpman (1993) has shown that even if stronger IPR protection increases the rate of Northern innovation in the short run, it could reduce the welfare of Southern consumers and could raise the welfare of Northern consumers by shifting production from low-price South to high-price North. Helpman's analysis has been refined by other studies that have relaxed a number of assumptions (Lai, 1998; Glass and Saggi, 2002). North-South models of Schumpeterian growth are well fitted to provide useful policy recommendations regarding the intense debate surrounding the Agreement on Trade Related Intellectual Property Rights (TRIPS), which was ratified by the members of the World Trade Organization (WTO) in 1995, and calls for stronger Southern IPR protection.



## Further Reading

- Aghion, Philippe, and Peter Howitt. 1998. *Endogenous Growth Theory*. Cambridge, MA, MIT Press. This graduate textbook provides a comprehensive analysis of endogenous growth theory.
- Dinopoulos, Elias, James F. Oehmke, and Paul S. Segerstrom. 1993. "High-Technology-Industry Trade and Investment: The Role of Factor Endowments", *Journal of International Economics* 34(1-2): 49-71. Earlier endogenous growth model that analyzes the nexus of factor endowments, product-cycle trade and multinational firms in a North-North framework.
- Dinopoulos Elias, and Paul S. Segerstrom. 1999. "A Schumpeterian Model of Protection and Relative Wages", *American Economic Review* 89(3): 450-472.
- Dinopoulos, Elias, and Peter Thompson. 1999. "Scale Effects in Schumpeterian Models of Economic Growth", *Journal of Evolutionary Economics* 9(2): 157-185. A review of available empirical evidence on the relationship between scale and growth and attempts to develop Schumpeterian growth without scale effects.
- Glass, Amy J., and Kamal Saggi. 2002. "Intellectual Property Rights and Foreign Direct Investment", *Journal of International Economics* 56(2): 387-410.
- Grossman, Gene M. and Elhanan Helpman. 1991. *Innovation and Growth in the Global Economy*, Cambridge, MA, MIT Press. This book presents a coherent theoretical framework that integrates the variety-based and quality-based approaches of earlier Schumpeterian models of growth in open economies.
- Helpman, Elhanan. 1993. "Innovation, Imitation and Intellectual Property Rights", *Econometrica* 61(6): 1247-1280.

- Jones, Charles I.. 1999. "Growth: With or Without Scale Effects?", *American Economic Review Papers and Proceedings* 89: 139-144. A short overview of semi-endogenous and fully endogenous Schumpeterian growth models.
- Krugman, Paul. 1979. "A Model of Innovation, Technology Transfer, and the World Distribution of Income", *Journal of Political Economy* 87(2): 253-266. One of the earliest models of North-South product-cycle trade based on innovating North and non-innovating South.
- Lai, Edwin. 1998. "International Intellectual Property Rights Protection and the Rate of Product Innovation", *Journal of Development Economics* 55(1) : 133-153.
- Schumpeter, Joseph. A. 1942. *Capitalism, Socialism and Democracy*. New York. Harper and Row. A comprehensive treatment of the role of the process of creative destruction in the evolution of capitalism.
- Segerstrom, Paul S., T.C.A. Anant, and Elias Dinopoulos. 1990. "A Schumpeterian Model of the Product Life Cycle", *American Economic Review* 80 (5), 1077-1091. One of the earliest models of Schumpeterian growth in open economies.
- Romer, Paul M. 1990. "Endogenous Technological Change", *Journal of Political Economy* 98 5(2): S71-S102. One of the earliest, influential and most widely-cited closed-economy Schumpeterian models of economic growth
- Sener, Fuat. 2001. "Schumpeterian Unemployment, Trade, and Wages", *Journal of International Economics* 54(1), 119-148.
- Taylor, Scott. 1993. "Quality Ladders and Ricardian Trade", *Journal of International Economics* 34(3-4), 225-249.