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A new decomposition approach to growth accounting: derivation of the formula and its application to prewar Japan

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Abstract

How can an economy grow in the early stages of economic development in the absence of total factor productivity growth, as has been allegedly the case in fast-growing East Asian economies? This paper advances the hypothesis that capital deepening associated with transformation of industrial structure can sustain growth for a long period without causing a decline in the rate of returns to capital. To examine our hypothesis, we develop a new decomposition formula for growth accounting that highlights such capital deepening. The formula is applied to data from prewar Japan, to assess the significance of industrial transformation in economic growth. © 2001 Elsevier Science B.V. All rights reserved.

Keywords: Structural transformation; Capital deepening; Total factor productivity growth; Growth accounting

1. Introduction

Kim and Lau (1994) and Young (1995) contend that it was accumulation of physical capital, and not total factor productivity (TFP) growth, that contributed to fast and long-lasting economic growth in the newly industrializing countries of East Asia. Krugman (1994) argues that the growth momentum of this region will be gradually lost as the rate of returns to capital continues to decline. Abramovitz (1993) and Hayami and Ogasawara (1999) present, however, historical data of the United States and Japan to show that contribution of TFP growth was small in early stages of economic development before research and educational capacity of the economy was improved in later stages.[1]

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[1] According to the recent study of Collins and Bosworth (1996), the contribution of TFP growth increased in East Asian NIEs in recent years.

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How could fast growth last long in the absence of TFP growth in the early stages of economic development? Traditionally, development economics has been concerned with structural change from agriculture-based to industry-led economies and from traditional to modern sectors (e.g. Fei and Ranis, 1964). If industrial structure changes from labor-intensive to capital-intensive sectors, the Hechscher–Ohlin model of international trade predicts that aggregate capital accumulation can take place without changing the capital–labor ratio in each sector (Rybczynski, 1955; Melvin, 1968; Leamer, 1987). If so, the rate of returns to capital may remain unchanged, even though the economy accumulates capital without technological changes up to some point.

An empirical hypothesis is that such capital accumulation-cum-structural transformation plays an important role in early stages of economic development before TFP growth becomes the engine of growth in later stages. This paper attempts to develop a growth accounting formula to measure growth effects of such structural transformation. The formula builds on the important work of Massel (1961), Ohkawa (1967), Denison and Chung (1976), Syrquin (1986), Jorgenson et al. (1987), and Pilat (1993).[2] Unlike existing decomposition formulas, which focus on the decomposition of TFP growth, ours highlights the effects of structural transformation on capital deepening, production efficiency, and growth.

We apply the formula to the data of the Japanese economy in the prewar period, during which capital deepening was a major contributor to the economic growth (Hayami and Ogasawara, 1999). We find that capital deepening associated with structural transformation accounted for 42 percent of labor productivity growth in the manufacturing sector as a whole in the 1930s. We also find that fast structural transformation is not necessarily efficient, as reflected in its negative efficiency effect.[3]

The rest of the paper is organized as follows. The next section develops the new formula. Section 3 applies it to the prewar data, in which the whole economy is classified into four sectors: primary, manufacturing and mining, other secondary, and tertiary. Section 4 applies the formula to the prewar data of the manufacturing sector classified into nine industrial subsectors. Section 5 discusses the implication of this study for industrial policies and future research.

2. Decomposition formula

This section develops a formula for decomposing sources of growth in labor productivity. Suppose that there are n sectors, and that sector i employs labor input L_i and capital

[2] Massel (1961) decomposes the rate of TFP growth into a weighted sum of TFP growth rates in individual sectors and a sum of structural effects. The structural effects arise, in his formula, when marginal value products are different among sectors. Ohkawa (1967) slightly modifies the Massel's formula to fit a dual economy. The formula developed by Denison and Chung (1976) also includes the effect of improved resource allocation. Syrquin (1986) distinguishes two components of labor productivity growth: a weighted sum of labor productivity growth rates in individual sectors and a structural effect. The structural effect arises when labor employment shifts from low-productivity to high-productivity sectors. Pilat (1993) applies the formula to the comparative data of the United States and Japan. By assuming translog production function, Jorgenson et al. (1987) decompose the rate of TFP growth into a weighted sum of sectoral TFP growth rates, contribution of changes in industrial structure, and contribution of changes in composition of different types of factor input.

[3] Young (1992) suggests that Singapore's rapid change in industrial structure bothered TFP growth.