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Product cycles and growth cycles☆

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ABSTRACT

This paper theoretically shows that shifts in production from developed countries (the North) to developing countries (the South) through imitation by the South can cause endogenous growth cycles. On the equilibrium path, the world economy continues to grow, but innovation, imitation, and the growth rate may permanently fluctuate. To show this, we construct a two-country overlapping generations model where the North develops new goods and the South imitates these goods endogenously. A key assumption is international knowledge spillover in the imitation process. The model implies that growth cycles tend to emerge when imitation in the South is more active.

1. Introduction

In recent years, international trade between developed countries (the North) and developing countries (the South) has been increasing. For example, US imports from China and Mexico have grown significantly since the 1970s, as shown in Fig. 1. In addition, the proportion of US imports from the South to US GDP increased from about 1% in 1970 to 2.4% by 1990, and to more than 7% by 2012.[1] Autor et al. (2013) reported that the share of low-income countries of US imports was only 9% in 1991, but this had reached 15% by 2000, and 28% by 2007. The increasing trend in North–South trade seems to be at least partly attributable to production shifts through technology diffusion from the North to the South.[2]

For the South, an important means of acquiring foreign technologies is imitation.[3] Imitation by the South entails negative impacts on

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[1] According to the Direction of Trade Statistics from the International Monetary Fund (IMF), US imports from emerging and developing countries were $9.8 billion in 1970, $145.9 billion in 1990, and $1242.2 billion in 2012. The US Department of Commerce estimated US nominal GDP at $1075.9 billion in 1970, $5979.6 billion in 1990, and $16155.3 billion in 2012.

[2] For example, in the late 2000s, Korea and Taiwan controlled almost 90% of the global market for flat panel displays, whose technology was initially developed in the US and commercialized in Japan (Chen and Chen, 2015). Similarly, a single Chinese firm currently produces nearly half of the world's microwave ovens (Ge and Ding, 2008; Luo et al., 2011), while in the pharmaceutical industry, India produces more than 20% of the world's generic drugs, with exports of pharmaceutical products accounting for more than $10 billion each year (Banerji, 2012; Joseph, 2015; Tyagi et al., 2014). Chinese firms also have a large global share of the production of some vitamins (Hong, 2014).

[3] Intermediate input imports and foreign direct investment can also serve as channels for technology diffusion. Keller (2004) surveys the literature on international technology diffusion.

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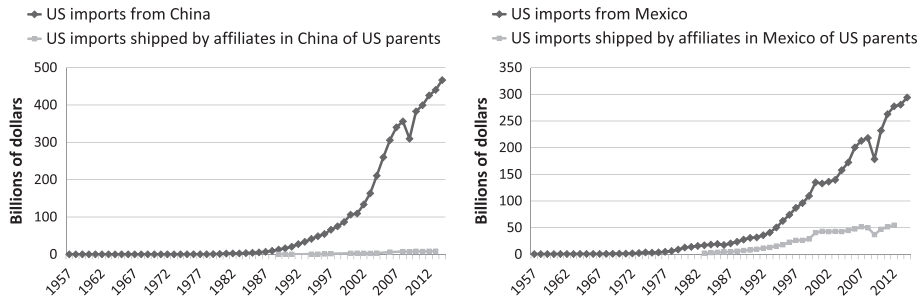

Fig. 1. US imports from China and Mexico.
Source: IMF "Direction of Trade Statistics", US Bureau of Economic Analysis "International Surveys: US Direct Investment Abroad".

the production, employment, and profits of Northern firms through shifts of production, so it is also likely to have an effect on resource allocation for research and development (R&D) in the North. Moreover, R&D in the North will in turn affect the productivity of imitation in the South because advanced knowledge created by R&D will likely result in technology spillovers to the South. Consequently, the North and the South will affect each other, and this interdependency may influence the total factor productivities (TFPs) and growth rates of both countries.

In this paper, we show theoretically that the shifts of production to the South due to imitation can bring about endogenous growth cycles in the North through the interdependency between the North and the South. To this end, we present a simple North–South model by combining the structures for preferences and production in Grossman and Helpman's (1991a) endogenous product cycle model with a two-period overlapping generations economy. In our model, a newly invented good is initially produced only in the North. After some time, a Southern firm learns how to produce this good through imitation and thereafter produces the good in the South. In the imitation process, our model assumes international knowledge spillovers from the North to the South, such that the greater the number of goods produced in the North, the easier it is for firms in the South to imitate these goods. This assumption reflects the fact that imitation is likely to be easier if, for instance, there is greater public knowledge accumulated in the development process of a new good and there are more potential targets for imitation.[4] The present model demonstrates that the product cycle through imitation can create a cyclical path and therefore maintain endogenous fluctuations in the growth rate of the world economy. As a result, the economy may repeatedly experience periods of relatively rapid economic growth followed by periods of relatively slow economic growth. On this path, innovation and imitation also continue to fluctuate, such that the difference in the technology level between the North and the South also exhibits perpetual fluctuation.

We can support the theoretical mechanism in the paper with some empirical observations. As discussed, US imports from the South have recently been increasing. Meanwhile, Comin and Gertler (2006) pointed out that the US economy after WWII has experienced medium-frequency variation quite unlike conventionally measured business cycles.[5] They argued that TFP and R&D have moved "procyclically" over the medium term in the US. In fact, Figs. 2 and 3 appear to show that the growth rates of TFP and business-funded R&D of the US oscillate over a relatively long cycle, as they were high in the early 1960s, the 1980s, and the 1990s but low in the 1970s and the 2000s.[6] In Section 5, we discuss how the equilibrium path of our model can explain these tendencies. The numerical results of our model show that both TFP growth rate and R&D expenditure growth rate continue to fluctuate procyclically while Northern imports increase monotonically and thus can explain the actual tendencies shown in Figs. 1–3.

In our model, the growth cycle originates from the processes of both innovation and imitation. When the number of goods produced in the North is small, the stock values of Northern firms are low, such that households direct a larger proportion of their savings to R&D investment. Accordingly, innovation increases as the production of goods in the North becomes smaller. However, the larger amount of innovation increases the number of Northern goods and the total stock values of the Northern firms operating in the *next* period. Therefore, for a given amount of savings, this process crowds out R&D investment and decreases innovation in the next period. This implies that more innovation in the present links with less innovation in the future, and vice versa, in our model. This mechanism brings about reiteration in the upturn and downturn of R&D and innovation.[7] Furthermore, the fluctuation in imitation is also essential for the R&D cycle because the number of goods produced in the North depends on the intensity of imitation. Our model implies that a

[4] Madsen et al. (2010) concluded that R&D activities in developing countries are predominantly imitative and that a technology gap between the US and a developing country has a statistically significant positive effect on the TFP growth rate of the developing country. These results seem to imply that the productivity of imitation depends positively on the technology gap between the North and the South.

[5] Comin and Gertler (2006) found growth undulation with a periodicity of more than eight years (longer than that typically considered in business-cycle analysis) by estimating the medium-term movements of per capita GDP growth for the US. Figure 3 in Gordon (2010) also illustrates that the long-run trend in the growth rate of hourly output in the US has varied substantially since at least the 1950s. If we interpret the North in the present model as a group of several developed countries, our model predicts that the economies of the developed countries fluctuate similarly because of the interdependency between the North and the South. This prediction is consistent with the fact that the correlations between GDP growth rates for the member countries of the Organisation for Economic Co-operation and Development (OECD) are generally high, as shown in Table 1 in Otto et al. (2001). Table B-22 in Maddison (2006) also shows that long-term (25–40 years) average growth rates in several developing countries (including Mexico, China, and India) have fluctuated. In addition, Figure 1 in Papageorgiou and Perez-Sebastian (2006) demonstrates that the development process in some East Asian countries has not been monotone and the growth rate of output has fluctuated in both Japan and Korea during the period of post-WWII growth.

[6] As also evidenced in the industry-level data in the Structural Analysis (STAN) Database maintained by OECD, the R&D intensities of some US industries—such as air and spacecraft and related machinery, chemicals and chemical products, and electrical equipment—have fluctuated and not been generally stable, even in the medium term, since the 1970s. The figures in Appendix F are available from the authors upon request.

[7] As discussed in Section 4.4, we can explain this effect using the equilibrium in the Northern labor market.