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Demographic change and economic growth: An inverted-U shape relationship

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Abstract

The cross-country regression and non-parametric kernel estimation using the panel data from OECD countries over the 1960–2000 periods show the inverted-U shape relationship between demographic changes and economic growth; growth rates initially increase and then decrease with population aging.

Keywords: Demographic change; Inverted-U shape relationship; Non-parametric estimation

JEL classification: J11; O40; O50

1. Introduction

The demographic trends over the past 50 years – which can be summarized as showing a steady decline in fertility rates and increase in life expectancy – is thought to have a powerful impact on the rate of economic growth. However, most empirical studies on the economic consequence of demographic change including Cutler et al. (1990), Bloom et al. (2000), Jones (2002), etc. find little cross-country evidence. Instead, there is a continuing debate over the demographic effects on economic growth. As discussed in Bloom et al. (2003), the debate involves three positions, such that demographic change (or

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population growth) restricts, promotes or is independent of economic growth, representing the "Pessimistic," "Optimistic," and "Neutralist" theories respectively.

The debate motivates us to attempt two tasks in this paper. First, we attempt to use more adequate demographic variables for studying its effect on economic performance. Fertility rate or life expectancy alone cannot be an accurate demographic indicator, since each captures only one part of population structure. As emphasized in Bloom and Canning (2004), the age structure of the population is an important measure of demographic change. So the index – the share of population over age 65 or the dependency ratios – provides richer information to determine economic performance than fertility rate or life expectancy alone. Since the age structure changes due to the combined effect of the fertility rate and life expectancy, both old age and young age dependency ratios can capture overall shape of demographic change in more appropriate way.[1] So we use the share of the old (young) and the old age dependency ratio (young age dependency ratio) as the proxies of the demographic transition.

For several decades we have observed a demographic transition from high fertility and high mortality to low fertility and low mortality.[2]

Since fertility and mortality rates do not decline at the same time, we can divide the demographic transition into three stages: high fertility/high mortality, high fertility/low mortality, and low fertility/low mortality. In the first stage, the share of the old (young) and the old (young) age dependency ratio are very low (high). Due to the longer life expectancy, the old share increases in the second stage. However, due to the increase in the young population caused by high fertility, the share of the old increases not rapidly but slowly. On the other hand, due to the increase in the old population, the share of the young decreases slowly. In the third stage, the share of the old increases rapidly and the share of the young decreases rapidly. Hence, increasing trends of both the old share and old age dependency ratio and decreasing trends of both the young share and young age dependency ratio can be used as the proxies for the demographic transition.

Second, pursuing a more rigorous investigation, we attempt to test the relationship of growth to the demographic change in terms of parametric and non-parametric estimates. In fact, the entire body of previous empirical research on demographic influence on economic performance has never paid attention to the non-monotonic relationship between economic growth and demographic changes. However, the demographic impact on economic growth is not as monotonic as perceived in recent works.[3] It may fluctuate to reflect a non-monotonic or non-linear relationship. As such, the nonlinearity can be tested in terms of its specifications including square and (or) cubic terms of demographic variables in the economic growth equation. In addition to this parametric test, we also attempt a non-parametric test, estimating the functional form itself in terms of the kernel regression.

This paper is organized as follows. The first section introduces the importance of demographic change and explains the motivation to analyze its impact on economic growth. In Section 2, we explain the

[1] Using dependency ratio rather than using both old age dependency ratio and young age dependency ratio together seems to be more appropriate, since dependency ratio reflects changes in both shares of the old and the young. However, it is very difficult to distinguish the high dependency ratio caused by high young age dependency ratio from that caused by high old age dependency ratio. The former appears in the earlier stage of demographic transition and the latter does in the later stage. These two show different effect on economic growth. Thus, we do not use the dependency ratio as the variable representing age structure.

[2] See Lee (2003). "The classic demographic transition starts with a mortality decline, followed after a time by reduced fertility, leading to an internal of first increased and then decreased population growth and, finally, population aging."

[3] Zhang et al. (2003) theoretically analyzed the non-monotonic relationship of economic growth to demographic changes.